2.0 Project Description

2.1 Introduction and Overview

The City of Palmdale proposes to construct, own, and operate the Palmdale Hybrid Power Project (PHPP or Project). The PHPP consists of a hybrid of natural gas-fired combined-cycle generating equipment integrated with solar thermal generating equipment to be developed on an approximately 377-acre site in the northern portions of the City of Palmdale (City). The combined-cycle equipment utilizes two natural gas-fired combustion turbine generators (CTG), two heat recovery steam generators (HRSG), and one steam turbine generator (STG). The solar thermal equipment utilizes arrays of parabolic collectors to heat a high-temperature working fluid. The hot working fluid is used to boil water to generate steam. The combined-cycle equipment is integrated thermally with the solar equipment at the HRSG and both utilize the single STG that is part of the Project.

The Project will have a nominal electrical output of 570 MW and commercial operation is planned for the summer of 2013. The solar thermal input will provide approximately 10 percent of the peak power generated by the Project during the daily periods of highest energy demand. The Project will be fueled with natural gas delivered via a new natural gas pipeline. The Southern California Gas Company (SCG) will design and construct the approximately 8.7-mile pipeline in existing street rights-of-way (ROW) within the City of Palmdale (see Figure 2-1 at the end of this AFC section, as are all figures in the section).

The PHPP plant site is located south of East Avenue M (E Ave M) in the northernmost areas of the City of Palmdale. The 377-acre plant site is part of an approximately 600-acre City-owned property that is bounded by Sierra Highway to the west, East Ave M (Columbia Way) to the north, and U.S. Air Force Plant 42 on the south and east. Air Force Plant 42 is a Government Owned Contractor Operated (GOCO) facility for the production, engineering, final assembly and flight testing of high performance aircraft. Under a Joint-Use Agreement with the U.S. Air Force, Los Angeles World Airport (LAWA) currently operates a passenger terminal on Air Force Plant 42 as LA/ Palmdale Regional Airport.

Note: To commemorate the City of Palmdale's rich aviation history and culture, some city streets are identified by both a geographic name (e.g. E Ave M) and a historic name (e.g., Columbia Way). Thus, East Avenue M is also sometimes referred to as Columbia Way, and 10th Street East is also called Challenger Way, in both cases commemorating the fact that all six of America's Space Shuttles were manufactured at Air Force Plant 42. This Application for Certification (AFC) primarily uses the geographic convention (10th Street East [10th St E]).

The proposed interconnection point for the PHPP with the Southern California Edison (SCE) electrical transmission system is at SCE's existing Vincent Substation south of Palmdale. Although the Vincent Substation is, approximately 11 miles south-southwest of the PHPP plant site as the crow flies, to accommodate the needs of Palmdale's aviation community (Air Force Plant 42 and LAWA), a circuitous transmission line route that is 35.6 miles long is planned that extends north and east from the plant site, then south and back to the west. The Project's transmission system will be constructed in two segments, as briefly summarized below, described in more detail in Section 2.5, and shown on Figure 2-1:

PHPP transmission line Segment 1 involves the construction of approximately 23.7 miles of 230-kV transmission line in new and existing rights-of way (ROW) between the Project site and SCE's Pearblossom Substation. As shown on Figure 2-1, beginning at the plant site, the route extends northward and eastward, then southward and finally back to the southwest. PHPP transmission line Segment 2 is a system reliability upgrade that includes increasing transmission capacity and expansion of the existing Vincent Substation. A new 11.9-mile double-circuit 230 kV line will be installed on new poles parallel to existing transmission lines in an existing ROW extending westward from the Pearblossom Substation to the Vincent Substation. Most of Segment 1 is within the City of Palmdale; the rest of Segment 1 and all of Segment 2 are in unincorporated Los Angeles County.

Reclaimed water for the Project's cooling tower makeup and other industrial uses will be supplied from the City of Palmdale Water Reclamation Plant (PWRP) located south of the plant site through a new 7.4-mile pipeline. The pipeline will be installed in existing City street ROWs primarily within the City of Palmdale, although a small portion of the pipeline in the immediate area of the PWRP is in unincorporated Los Angeles County (see Figure 2-1).

The Project's backup cooling water supply will also be reclaimed water. The Antelope Valley recently drafted an Integrated Regional Water Management Plan (AVIRWMP). The AVIRWMP proposes a reclaimed water backbone system, linking the City of Palmdale with the City of Lancaster, both of whose wastewater treatment plants will be producing reclaimed water. While no final decision has been made yet with respect to the point of interconnection between the two systems, the intersection of Sierra Highway and E Ave M is proposed, which is along the Project's reclaimed pipeline route. Thus, the Project's backup water supply would not require additional pipeline construction. In the event of an outage in the PWRP reclaimed water production system, the PHPP will utilize the regional backbone system to provide a source of reclaimed water to serve as a backup for the Project's cooling water supply.

The PHPP will be a zero liquid discharge (ZLD) design; no offsite industrial liquid waste discharge will occur. Brine (cooling water blowdown) from the Project will be processed to solid waste and disposed at an appropriately permitted offsite disposal facility.

During Project operations, potable water for drinking, sanitary uses, safety showers, etc. will be obtained from the Los Angeles County Waterworks District No. 40. LA County Waterworks District No. 40 has a potable water pipeline along E Ave M that currently terminates a short distance west of the plant site's northern border. A 1.0-mile pipeline along E Ave M will be constructed to connect the PHPP to the existing pipeline (see Figure 2-1). Portable sanitary facilities and bottled water will be used during Project construction.

Sanitary wastewater will be disposed by connecting to the Los Angeles County Sanitation District's sewer system. The County Sanitation District has an existing 12 sewer line that runs along E Ave L. The Project will connect to the existing sewer line at an existing manhole located at E Ave L and 10th St E (Challenger Way), approximately 1.0 mile north of the plant site (see Figure 2-1).

The Project owner and applicant submitting this Application for Certification (AFC) is the City of Palmdale, a municipal corporation in the State of California. The PHPP is expected to supply power to the rapidly growing southern California market. The City has contracted with Inland Energy, Inc. to develop the Project.

2.2 Location of Facilities

The PHPP address is 950 E Ave M, Palmdale, California. As shown on Figure 2-1, the Project site is located on an approximately 377-acre parcel west of the northwest corner of U.S. Air Force Plant 42, and east of the intersection of Sierra Highway and E Ave M. The power plant site and 50 acres adjacent to the west that will be used as a construction laydown area are currently vacant and undeveloped land owned by the City of Palmdale. Figure 2-1 illustrates the location of the power plant site, as well as the proposed Project transmission line route, and the routes of the Project's natural gas supply, water supply, and sanitary wastewater disposal pipelines.

The plant site and most linear facilities routes are entirely within the City of Palmdale. As noted above, most of Segment 1 of the transmission line is within the City of Palmdale; the remainder of Segment 1 and all of Segment 2 are in unincorporated Los Angeles County. Similarly, a small portion of the reclaimed water supply pipeline is in unincorporated Los Angeles County with the remainder in the City of Palmdale. The transmission line and various pipeline easements are either along City-controlled parcels, land owned by the applicable utility (e.g., SCG and SCE), or are on land that the City intends to purchase. Please note that the City has the power to condemn any necessary easements if purchase cannot be arranged.

2.3 Site Description

The following paragraphs describe the PHPP power plant site. Information on the process that led to the selection of the proposed plant site is provided in Section 4.2, Project Site Alternatives.

2.3.1 Existing Site Condition

The PHPP plant site is located in an industrial area of the City of Palmdale. The site is currently vacant and undeveloped. A photograph of the site in its current condition is presented as Figure 2-2. The site is largely flat, with elevations ranging from approximately 2,493 feet to 2,535 feet above sea level.

The legal description of the plant site is as follows: a portion of Section 1, Township 6 North, Range 12 West, (San Bernardino Base and Meridian), located within the north of the City of Palmdale, on a 300-acre site. A list of the assessor's parcel numbers that comprise the plant site is provided in Table 2-1. A new parcel will be created that corresponds with the 377-acre PHPP plant site. Ownership information for the properties surrounding the plant site and along the linear facilities routes is provided in Appendix A**.**

2.3.2 Site Surveys

Detailed land and topographic surveys were performed to establish site boundaries, to understand grading requirements and to establish a baseline drainage plan. A preliminary geotechnical report of the PHPP plant site was performed to evaluate general subsurface conditions, seismicity and other geologic hazards and to provide recommendations for design and construction of the foundations for Project structures. A copy of this report is included as AFC Appendix B.

In general, the study found the plant site geotechnically feasible for construction of the proposed electrical generating facilities. Supplementary geotechnical investigations will be performed to support detailed

design. Engineering design criteria for the Project (foundations and civil, seismic and structural, mechanical, control systems, and electrical) are provided in AFC Appendix C.

Table 2-1 PHPP Plant Site Parcels- Assessor's Parcel Numbers (APN)

3126-017-012	3126-017-027	3126-022-039	3126-022-901	3126-026-010
3126-017-013	3126-017-028	3126-022-041	3126-022-903	3126-026-011
3126-017-014	3126-017-030	3126-022-042	3126-022-904	3126-026-013
3126-017-015	3126-017-031	3126-022-043	3126-025-900	3126-026-015
3126-017-016	3126-017-032	3126-022-044	3126-022-002	3126-026-016
3126-017-017	3126-017-033	3126-022-045	3126-022-003	3126-026-017
3126-017-018	3126-017-036	3126-022-046	3126-026-001	3126-026-019
3126-017-020	3126-017-037	3126-022-047	3126-026-002	3126-026-020
3126-017-021	3126-017-038	3126-022-048	3126-026-003	3126-029-902-
3126-017-023	3126-022-035	3126-022-049	3126-026-004	
3126-017-024	3126-022-036	3126-022-050	3126-026-005	
3126-017-025	3126-022-037	3126-022-051	3126-026-006	
3126-017-026	3126-022-038	3126-022-052	3126-026-007	

2.4 Generating Facility Description

The following sections describe the PHPP site arrangement and the processes, systems and equipment that constitute the proposed power plant. All Project facilities will be designed, constructed and operated in accordance with applicable laws, ordinances, regulations and standards (LORS). Figure 2-3a is an aerial photograph showing the Project site and surrounding area at the present time; Figure 2-3b is the same aerial photograph with the simulated PHPP facilities added.

2.4.1 Site Arrangement

Figure 2-4 shows the layout of Project facilities including:

- Plant site and laydown area,
- The onsite portions of the Project's natural gas supply, reclaimed water supply, potable water supply and sanitary wastewater pipelines
- The approximately 250-acre solar array field with associated heat transfer equipment, and
- The beginning of Segment 1 of the Project transmission line.

Figure 2-5 is a plot plan/general arrangement of the Project's power block. As shown on Figure 2-5, major components of the Project include:

- Two CTGs each with a HRSG,

- One STG,
- One wet cooling tower,
- A 230-kV switchyard,
- An operations building that incorporates control, warehouse, maintenance, and administrative functions, and
- A gas metering station.

Elevation drawings of the plant site looking north and looking west are provided in Figure 2-6.

2.4.2 Process Description

This section describes the power generation process and thermodynamic cycle employed by the Project. The power plant consists of:

- Two CTGs equipped with dry low NO_x combustors and evaporative inlet air coolers,
- Two HRSGs equipped with duct burners,
- One STG, and
- Approximately 250-acre solar thermal array field with a solar steam boiler and associated auxiliary systems and equipment.

The CTGs and duct burners are fueled exclusively with pipeline natural gas. The duct burners provide additional heat, which enable the HRSGs to produce more steam in order to obtain peaking output from the STG.

During periods when the solar collectors are in use (i.e., daytime when the sun is shining on the site), the solar field will provide heat directly to the HRSGs to produce more steam, which will allow the facility to reduce firing of the duct burners. This design feature enhances the Project's ability to respond to the energy markets by providing additional power during peak demand periods (e.g., hot summer afternoons), while consuming less natural gas fuel.

At full load, each CTG generates approximately 154 MW (gross) at average ambient conditions. Heat from the CTG exhausts is used in the HRSGs to generate steam and to reheat steam. With the CTGs at full load and the duct burners and solar field out-of-service, the HRSGs produce sufficient steam for operation of the STG at an output of 169 MW (gross) at average ambient conditions, which results in an overall plant output of approximately 477 MW (gross) (see Table 2-2).

With the CTGs at full load and the duct burners in-service, the HRSGs produce sufficient steam for operation of the STG at its peaking output of 267 MW (gross) at average ambient conditions, which results in an overall plant gross output of approximately 563 MW (net). At full load solar operation, the heat from the solar field can replace the equivalent of approximately 50 MW of duct firing, thereby improving the Project's overall heat rate and reducing air emissions.

Table 2-2 Generation Configurations and Output in MW

Configuration	Output
Full Load (average ambient conditions) / No Duct Burners/No Solar	477 MW
Full Load (average ambient conditions) / Full Duct Burners/No Solar	563 MW
Full Load (average ambient conditions) / Partial Duct Burners/Full Solar	563 MW
Full Load (average ambient conditions) / No Duct Burners/Full Solar	527 MW

Overall, annual availability of the PHPP is expected to be in the range of 90 to 95 percent. The plant's capacity factor will depend on the provisions of bilateral power sales contracts, as well as market prices for electricity, ancillary services, and natural gas. The design of the Project provides for operating flexibility (the ability to rapidly start up, shut down, turn down and provide peaking output), so operations may be readily adapted to changing market conditions. Included in this flexibility is the ability of the Project to start up the combined-cycle system in approximately one-half the time of the industry standard for combined-cycle plants it the United States.

The "Rapid Start Process" (RSP) offered by General Electric Power Systems (GE), the supplier of the Project's combustion equipment, allows for faster starting of the gas turbines by mitigating the restrictions of former HRSG designs. Traditionally, the CTGs are brought to full load slowly to limit combined stresses in the high-pressure steam drum of the HRSG, due to the exhaust temperature of the CTGs. The new GE design eliminates this restriction by modifying the steam drum design. Additional equipment to support the RSP includes an auxiliary boiler, which will supply sealing steam and allow startup of the steam turbine, shortly after the gas turbines.

A heat balance diagram corresponding to base load operation of the PHPP is shown in Figure 2-7a. This base load heat balance is based on average ambient conditions of 70°F/40% relative humidity, evaporative coolers in-service, and duct burners out-of-service. A heat balance diagram corresponding to peak load operation of the facility is shown in Figure 2-7b. This peak load heat balance is based on the same average ambient conditions as the base load heat balance, with evaporative coolers in service, and duct burners in service providing the STG with extra steam for peaking output. A heat balance diagram corresponding to peak-load hybrid operation with full solar input for the facility is shown in Figure 2-7c. This peak load heat balance is based on the same average ambient conditions as the base load heat balance, with evaporative coolers in-service, and duct burners in-service (but turned down), with the solar input on line providing the HRSG with extra steam for peaking output to the STG.

The following provides a brief description of the combined-cycle equipment's thermodynamic cycle (a combination of the Brayton and Rankine cycles):

- Air flows through the inlet air filter, evaporative cooler, and associated inlet air ductwork of each CTG and is then compressed in the CTG compressor.
- Compressed air exiting the compressor flows to the CTG combustors.

- Natural gas fuel is then injected into the combustors and ignited. The hot combustion gases expand through the CTG's turbine to drive the entire CTG, including the compressor and the electric generator which share a common shaft with the turbine.
- The hot combustion gases exit the turbine and enter the HRSG dedicated to that CTG. Duct burners installed in each HRSG further heat the CTG exhausts at times when peaking output is desired.
- In the HRSGs, heat from the CTG exhausts is transferred to water pumped into the HRSG pressure parts (economizers, evaporators, drums, etc.).
- The water is converted to superheated steam and is delivered to the STG at three pressures, high pressure (HP), intermediate pressure (IP), and low pressure (LP). Note: The use of multiple steam delivery pressures provides an increase in cycle efficiency.
- HP steam from the HRSG is admitted to the HP section of the STG, the steam expands through the HP section to drive the STG, and exits the HP section as 'cold reheat' steam.
- Cold reheat steam is combined with IP steam from the HRSG and delivered to the HRSG reheater.
- Hot reheat steam leaving the reheater is admitted to the IP section of the STG and expands through the IP and LP sections to further drive the STG.
- LP steam from the HRSG is admitted to the LP section of the STG and expands through the LP section to also further drive the STG.
- Steam leaving the LP section of the STG enters a surface condenser, gives up its latent heat to circulating water, and is condensed to liquid.
- The circulating water flows through a wet cooling tower where the waste heat is rejected to the atmosphere and the circulating water is then pumped back to the surface condenser.

The cycle described above does not change with the addition of the solar thermal hybrid concept. Following is a brief description of the solar thermal process and how it is integrated into the overall system:

- Light from the sun reflects off the solar collector's parabolic troughs and is concentrated on tubes located at the focal point of the parabola that contain a high-temperature heat transfer fluid (HTF).
- The concentrated sunlight heats the HTF, which flows in tubes to a boiler and heat exchanger and then back to the solar field.
- Steam from the solar boiler is then fed into the HRSG's high-pressure steam drum to add heat to the steam cycle. This solar steam addition reduces the need for duct burning to meet peak power demands.

The HTF planned for use is Therminol™ VP-1 (or similar formulation), a high temperature, low-pressure oil widely used in solar thermal and other heat transfer applications. The HTF is a low vapor-pressure fluid that allows the solar system to remain at low pressure, thereby enhancing safety by reducing the likelihood of leaks.

2.4.3 Energy Conversion Facilities Description

This section describes the major energy conversion components of the proposed PHPP including the CTGs, HRSGs, STG, and solar system.

2.4.3.1 Combustion Turbine-Generators (CTG)

Thermal energy is produced in each of the two CTGs through the combustion of natural gas. The thermal energy is then converted into mechanical energy by the CTG turbine that drives the CTG compressor and electric generator. The CTGs proposed for the PHPP employ 'F' technology and are supplied by GE Power Systems. Each CTG consists of a heavy duty, single shaft, combustion turbine-generator and associated auxiliary equipment. The CTGs are equipped with dry low NO_X combustors designed for natural gas. Procurement of the CTGs is based on functional performance criteria, including the following:

- Air emissions at the gas turbine exhaust shall not exceed specified levels.
- Noise emissions shall not exceed specified near-field and property line levels.
- Each CTG shall be capable of operating at 50 percent to 100 percent load, while meeting specified air emissions performance criteria.
- Each CTG shall be capable of a specified number of startups per year.

The CTGs are equipped with accessories required to provide efficient, safe and reliable operation, including the following:

- Inlet air filters and on-line filter cleaning system,
- Evaporative inlet air coolers,
- On-line and off-line compressor wash system,
- Fire detection and protection system,
- Lubrication oil system including oil coolers and filters,
- Generator coolers,
- Starting system, auxiliary power system, and control system, and
- Metal acoustical enclosures designed for outdoor service.

2.4.3.2 Heat Recovery Steam Generators (HRSG) and Steam Cycle

In the combined-cycle configuration, each gas turbine will exhaust to a dedicated HRSG. Each of the two trains will consist of one CTG and one HRSG. Both CTG-HRSG trains will feed steam into a common STG (a standard 2-on-1 configuration).

Each HRSG is a horizontal, natural circulation type unit with three pressure levels of steam generation and reheat loop. High-pressure steam at 1,800 pounds per square inch gage (psig) and 1,050°F is produced in the HRSG and flows to the steam turbine throttle inlet. The exhausted cold reheat steam is

mixed with intermediate pressure steam and reintroduced into the HRSG through the reheat loop. The hot reheat steam flows to the intermediate-pressure section of the STG and then to the low-pressure section of the STG. Low-pressure steam from the HRSG also flows to the low-pressure section of the STG. The STG drives an electric generator to produce electricity.

In the proposed hybrid configuration with the solar thermal component integrated into the Project, additional HP steam is produced during daylight hours from heat collected via the solar array. The solar array heats a working fluid that is used to produce HP steam in a heat exchanger. This HP steam is re-introduced into the combined-cycle system via injection of the solar-generated saturated HP steam into the HP drum of the HRSG. This steam is then superheated in the HRSG superheaters along with the HP steam produced within the HRSG evaporator. The STG exhaust steam is condensed in the de-aerating surface condenser with water from a multi-cell wet cooling tower.

Make-up water to the cooling tower will be tertiary treated water from the Palmdale Water Reclamation Plant brought to the site by a new approximately 7.4-mile pipeline. Blowdown from the cooling tower will be processed in the onsite ZLD system.

GE "Rapid Start Process" (RSP). As noted earlier, the PHPP is designed with GE's RSP, which will allow the CTG to reach base load more quickly, reducing startup emissions. Since emission rates are higher during startup, than during normal steady-state operations, RSP will facilitate the Project's compliance with air emission requirements. Table 2-3 shows the startup rates with and without the RSP. As shown in the table, the RSP reduces CTG startup rates most substantially (by more than 50 percent) during cold starts, with smaller reductions in startup time during warm and hot starts. The RSP does not affect STG startup times.

To facilitate the RSP approach, the HRSG design will be modified. Typical HRSG designs limit the CTG start rate, due to the exhaust temperature heating the steam drum too quickly. This limitation is caused by thermal stress limitations on the high-pressure steam drum due to the shell thickness. To avoid this limitation, a modified drum design will be used that allows for thinner wall thickness. This revised design is achieved by elongating the steam drum and reducing its diameter, which allows the steam drum volume to remain relatively unchanged.

Table 2-3
Time (Minutes) to Full Load With and Without GE "Rapid Start Process"

Component	Cold	Warm	Hot
GT1 (Typical)	210	102	62
GT1 (RSP)	70	40	40
GT2 (Typical)	240	124	83
GT2 (RSP)	103	71	71
STG (Typical/RSP)	240	130	130

An alternative approach was considered to reduce combined-cycle system startup times. The alternative included a "once-through" boiler that controls feed water by rate control. This design removes the high-

pressure steam drum as the limiting component by eliminating it completely. However, the modified drum design described above provides equivalent rapid startup capability without the increased sensitivity to water purity and the need for additional purification equipment associated with the once-through boiler. The once-through boiler approach also removes the planned solar heat input location (high-pressure steam drum), which complicates the Project's hybrid approach (integrated combined-cycle and solar equipment).

Auxiliary Boiler. Another limiting factor for startup of combined-cycle equipment is the ability to draw a vacuum on the condenser, which is necessary to commence STG startup. The PHPP will use an auxiliary boiler to facilitate rapid startup by providing STG sealing steam prior to CTG startup, thereby allowing the condenser vacuum to be established and the condenser be in a condition ready to accept steam as soon as it is needed. This also avoids the need to vent considerable steam to the atmosphere while waiting for condenser vacuum to be established following CTG start and the beginning of steam generation within the HRSG.

2.4.3.3 Steam Turbine-Generator (STG)

Steam from the HRSGs is sent to the STG. The steam expands through the STG turbine blades to drive the steam turbine, which in turn drives the generator. The PHPP's STG is a "reheat" type and is equipped with accessories required to provide efficient, safe, and reliable operation, including the following:

- Governor system,
- Steam admission system,
- Gland seal system,
- Lubrication oil system including oil coolers and filters,
- Generator coolers, and
- Metal acoustical enclosures designed for outdoor service.

2.4.3.4 Solar Thermal Field System Description

The following subsections describe the solar thermal component of the PHPP.

Description of Technology. The collector field is made up of a large field of diurnal, single-axis-tracking parabolic trough solar collectors. The solar field is modular in nature and comprises many parallel rows of solar collectors, normally aligned on a north-south horizontal axis (see Figures 2-8 and 2-9). Each solar collector has a linear parabolic-shaped reflector (referred to as the Heat Collection Element (HCE) that focuses the sun's direct beam radiation on a linear receiver located at the focus of the parabola.

The collectors track the sun from east to west during the diurnal cycle to ensure that the sun is continuously focused on the linear receiver. A more specific description of the HCE is provided below under "Solar Field Components".

The heat transfer fluid (HTF) is heated up to approximately 740°F as it circulates through the receiver and returns to a series of heat exchangers, where the fluid is used to generate high-pressure steam. At the Project, these heat exchangers are located in the combined-cycle power block (the area where the CTGs, HRSGs, and STG are located). To integrate the solar and combined-cycle Project components, the solar-generated high-pressure steam is sent to the HP steam section of an on-site HRSG, and, thereby, contributes to the output of the Project's STG.

Parabolic trough solar technology is the most proven and lowest cost large-scale solar power technology available today and is in service at nine commercial-scale SEGS facilities in the California Mojave Desert at Harper Lake, Kramer Junction, and Daggett. More than 2,000,000 m^2 of parabolic trough collector technology have been operating daily for nearly 20 years, and in the aggregate have accumulated nearly 200 "plant years" of operational experience. Although no new SEGS plants have been built since 1990, significant advancements in collector and plant design have been made possible by the efforts of the SEGS operators, the parabolic trough industry and the solar research laboratories around the world. These improvements include advancements in mirror durability in high winds, receiver efficiency, structural design, cost reduction and system control.

Major Solar Equipment. The major pieces of equipment for the solar portion of the PHPP, each of which is discussed below, are as follows:

- Solar field and components (Solar collector assembly [SCA] and heat collection elements [HCE]);
- HTF,
- Mirrors
- Connectors
- Solar boiler
- Heater for the HTF
- HTF surge tanks,
- HTF ullage system, and
- HTF piping headers.

Solar Field and Components. The solar field will encompass approximately 250 acres and will utilize solar trough technology similar to the nine existing SEGS units in the California Mojave Desert, but with substantially improved designs compared to the SEGS plants that were built in the late 1980s and early 1990s. The solar trough design utilized at the SEGS plants has demonstrated excellent field reliability. The solar field at the Kramer Junction SEGs facilities has shown an average reliability of approximately 99 percent in recent years; for this reason, similar reliability is expected for the PHPP solar field.

The HCE is the core of the solar plant and is a primary reason for the high efficiency of the parabolic trough collector design. The HCE consists of a 70 mm steel tube with a cermet (ceramic and metal substance) selective surface, surrounded by an evacuated glass tube. The HCE incorporates glass-to-metal seals and metal bellows to achieve the vacuum-tight enclosure. The vacuum enclosure serves primarily to protect the selective surface and to reduce heat losses at the high operating temperatures.

The vacuum in the HCE is maintained at about 0.001 mm Hg (0.013 Pa). The cement coating is sputtered (a physical vapor deposition processes used for tailoring optical properties) onto the steel tube to give it excellent selective heat transfer properties with an absorptivity of 0.96 for direct beam solar radiation and a design emissivity of 0.19 at 350ºC (662ºF). The outer glass cylinder has anti-reflective coating on both surfaces to reduce reflective losses from the glass tube. Getters (metallic substances that are designed to absorb gas molecules) are installed in the vacuum space to absorb hydrogen and other gases that permeate into the vacuum annulus over time.

The solar collector assemblies (SCA) rotate around the horizontal north/south axis to track the sun as it moves through the sky during the day. The axis of rotation is located at the collector center of mass to minimize the required tracking power. The drive system uses hydraulic rams to position the collector. A closed loop tracking system relies on a sun sensor for the precise alignment required to focus the sun on the HCE during operation to within +/- 0.1 degrees. The tracking is controlled by a local controller on each SCA. The local controller also monitors the HTF temperature and reports operational status, alarms, and diagnostics to the main solar field control computer in the control room. The SCA is designed for normal operation in winds up to 25 mph (40 km/h) and somewhat reduced accuracy in winds up to 35 mph (56 km/hr). The SCAs are designed to withstand winds in excess of 75 mph (120 km/hr) when in their stowed position (the collector aimed 30º below eastern horizon).

Heat Transfer Fluid. Therminol™ (VP-1), manufactured by Monsanto, or a similar formulation, will be used as the HTF. Therminol is a special high-temperature oil that has an excellent operating history and is used in many heat transfer processes. The Material Safety Data Sheet (MSDS) for Therminol™ is provided in AFC Appendix D. Therminol™ VP-1 is an aromatic hydrocarbon, biphenyl-diphenyl oxide. The oil is classified as non-hazardous by the federal government, but is regulated as a hazardous material by the State of California.

Mirrors. The current low iron glass mirrors are one of the most reliable components in the solar collectors. There has been no long-term degradation in the reflective quality of the low iron glass mirrors; ten year-old mirrors can be cleaned and brought back to like-new reflectivity. Long term endurance of the mirror, as measured by the experience at SEGS, indicates that mirror life of 35 years or more can be expected for the PHPP.

Development of an efficient and cost-effective program for monitoring mirror reflectivity and washing mirrors is critical. Differing seasonal soiling rates (higher in the summer) require flexible procedures. O&M procedures at the SEGS plants are well established and thus available for use on the Project. All cleaning methods use demineralized water for best effectiveness. The periodic monitoring of mirror reflectivity provides a valuable quality control tool for mirror washing and helps to optimize mirror washing labor. As a general rule, the reflectivity of glass mirrors can be returned to design levels with a good washing.

Connectors. A hard piped assembly with ball joints that connect the SCAs to the headers and SCAs to each other is being used at the SEGS plants at Kramer Junction and at the recently completed (2007) Nevada Solar One project near Las Vegas. The new ball joint assembly has a number of advantages over previous designs using flex hoses, including lower cost, lower head loss, and reduced heat losses. The new ball joint assemblies will be included in the design of the PHPP.

Solar Boiler. The solar boiler will be typical of the design used reliably in the SEGS units for over 20 years. Solar boilers are designed differently than conventional gas-fired boilers in that they are "fired" with hot oil instead of hot gasses. This design is similar to any shell and tube heat exchanger, in that the hot HTF is circulated through tubes and the steam is produced on the shell side. Although unique, the design is readily available from multiple manufacturers.

HTF Oil Heater. To eliminate the problem of oil freezing, an oil heater will be installed and used to ensure system temperature stays above 54° F whenever the unit is off-line. This type of system has been reliably used in the SEGS system for over 20 years.

HTF Surge Tank. To accommodate the volumetric change that occurs when heating the HTF to the operating temperature, surge tanks are required. Nitrogen will be used to provide a blanket on the headspace of the tank. The nitrogen prevents oxidation or contamination of the HTF by reducing its exposure to atmospheric air and also significantly reduces potential evaporative emissions.

HTF Ullage System. During plant operation HTF will degrade into components of high and low boilers (substances with high and low boiling points). The low boilers are removed from the process through the ullage system. HTF is removed from the HTF surge tank and flashed leaving behind high boilers and residual HTF. The flashed vapors are condensed and collected in the ullage system.

HTF Piping Header. To transport the HTF throughout the site, supply and return piping is routed to allow for balanced flow through all the HCEs. Expansion loops will be located through the plant as required to maintain the composite pipe stress within ASME B31.1 Power Piping code allowable limits. The composite pipe stress includes seismic and thermal stresses. It is anticipated that the solar field will be divided into several sections with automatic or semiautomatic isolation valves. The isolation valves will either be triggered automatically, e.g., by ground acceleration in the event of an earthquake, or by the operator inside the control room. The sectional isolation valves will be located to control the maximum volume of HTF leakage during a pipe failure. The piping in the solar array will be designed and constructed to allow movement due to thermal expansion – the steel piping in the mirrored trough sections of the array will be connected to the HTF distribution headers with ball joints and the piping will not be rigidly mounted to foundations or other structures, structurally decoupling the system from seismic ground shaking in the event of an earthquake.

2.4.4 Electrical System Description

This section describes the major electrical systems and equipment proposed for the PHPP. Almost all of the power produced will be delivered to the regional grid through the Project's interconnection with the SCE transmission system (the Project's transmission system is discussed in Section 2.5). A small amount of the Project's output will be used on-site for plant auxiliaries such as pumps, control systems and general facility loads including lighting and heating-ventilation-air conditioning (HVAC). Some of the power needed for on-site uses will be converted from alternating current (AC) to direct current (DC) for power plant control systems and emergency backup systems. The descriptions of the major electrical systems and equipment provided in the following subsections reflect AC power unless otherwise noted. An overall one-line diagram of the major electrical systems is presented in Figure 2-10. Additional electrical schematics are provided in Appendix F, System Impact Study.

2.4.4.1 Major Electrical Equipment and Systems

A small amount of the Project's electric power output will be used onsite to power auxiliaries and general facility loads. Power will be generated by the two CTGs and one STG at 18 kV and stepped up by three fan-cooled generator step-up transformers to 230 kV for transmission to the grid. Auxiliary power will be back-fed through two of the step-up transformers. Once the CTGs are running, they will supply the plant auxiliary power. Surge arresters will be provided at the high-voltage bushings to protect the transformers from surges on the 230-kV system, caused by lightning strikes or other system disturbances. The transformers will be set on concrete pads within berms designed to contain the non-PCB transformer oil in the event of a leak or spill. Fire protection systems will be provided. The high-voltage side of the step-up transformers will be connected to 230-kV circuit breakers, then to overhead lines that extend off-site to connect with SCE's regional transmission system at the Vincent Substation.

2.4.4.2 Grounding

The electrical system is susceptible to ground faults, lightning strikes and switching surges that result in high voltage potential hazards to site personnel and electrical equipment. The station grounding system provides an adequate path to permit the dissipation of current created by these events. The station-grounding grid will be designed for adequate capacity to dissipate heat from ground current under the most severe conditions in areas of high ground fault current concentration. The grid spacing will maintain safe step voltage gradients.

Bare conductors will be installed below-grade in an engineered grid pattern. Each junction of the grid will be bonded together by an exothermic weld or compression connection. Ground resistivity readings will be used to determine the necessary numbers of ground rods and grid spacing to ensure safe step and touch potentials under severe fault conditions. Grounding stingers will be brought from the ground grid to connect to building steel and non-energized metallic parts of electrical equipment.

2.4.4.3 Electrical Generation

Power is generated at 18 kV by the two CTGs and STG, and then is stepped up to 230 kV for delivery to the power plant's interconnection with the regional grid. Each of the Project's three generators is connected by 18-kV bus to an 18/230-kV oil-filled, step-up transformer dedicated to the generator. Each step-up transformer rests on a concrete pad designed to contain the transformer oil in the event of a leak or spill. The 230-kV side of each step-up transformer is connected by overhead conductors to a breaker and one-half 230-kV switchyard at the plant site.

2.4.4.4 Electrical System for Plant Auxiliaries

Power for plant auxiliaries is supplied at 4160V from three auxiliary transformers. The 18-kV bus of each CTG is provided with a tap connection to an 18-kV/4160-V oil-filled, step-down, auxiliary transformer. The 4160V side of each transformer is connected to 4160V switchgear. Each CTG is provided with an 18-kV generator breaker located between the generator and the tap connection. This configuration allows power for plant auxiliaries to be supplied from the plant switchyard regardless of whether the CTGs and STG are online or offline. The auxiliary transformers rest on concrete pads designed to contain the transformer oil in the event of a leak or spill.

The 4160V switchgear distributes power to the plant's 4160V motors, to the CTG starting system and to the 4160/480V transformers. The low voltage side of the 4160/480V transformers is connected to 480V switchgear. The 480V switchgear distributes power to the plant's large 480V loads and to 480V motor control centers (MCCs). The MCCs distribute power to the plant's intermediate 480V loads and to power panels serving small 480V loads. The MCCs also distribute power to 480/277V isolation transformers serving 277V single-phase loads and to 480/208/120 transformers serving 208V and 120V loads.

2.4.4.5 DC Power Supply System

The plant's DC power supply system consists of a 125VDC battery, a 125VDC battery charger, metering, ground detectors and distribution panels. In addition, a similar DC power supply system is provided as part of each CTG's auxiliary power system. Under normal operating conditions, the battery charger supplies DC power to the DC loads. The battery charger receives 480V, three-phase AC power from the electrical system serving plant auxiliaries. The battery charger continuously charges the battery bank, while supplying DC power to the DC loads. Under abnormal or emergency conditions when AC power is not available, the battery bank supplies DC power to the DC loads. The battery bank is sized to power the DC loads for a sufficient amount of time to provide for safe and damage-free shut down of the power plant. Recharging the battery bank occurs whenever AC power becomes available.

The DC power supply system provides power for critical control circuits, power for control of the 4160V and 480V switchgear and power for DC emergency backup systems. Emergency backup systems include DC lighting and DC lube oil and seal oil pumps for the CTGs and STG.

2.4.4.6 Essential Service AC Systems

An essential service AC system (120V, single-phase) provides power to essential instrumentation, critical equipment loads, safety systems and equipment protection systems that require uninterruptible AC power. The essential service AC system and the DC power supply system are both designed to ensure that critical safety and equipment protection control circuits are always energized and able to function in the event of unit trip or loss of AC power.

The essential service AC system consists of an inverter, a solid-state transfer switch, a manual bypass switch, an alternate AC source transformer and voltage regulator and AC panel boards. The DC power supply system is the normal source of power to the essential service AC system. Power flows from the DC power supply system through the inverter to the AC panel boards. The solid-state transfer switch continuously monitors both the inverter output and the alternate AC source. Upon loss of the inverter output and without interruption of power, the transfer switch automatically transfers essential service AC loads from the inverter output to the alternate AC source. The manual bypass switch enables isolation of the inverter and transfer switch for testing and maintenance without interruption of power to the essential service AC loads.

2.4.4.7 Emergency Generator

The emergency diesel generator will supply electrical power to the power plant critical services in the event of a total power outage of the switchyard and the plant. The plant critical services will include battery chargers, turning gear, lubricating oil systems, DCS/PLC controls and critical lighting.

The generator will be designed, tested, rated, assembled and installed in accordance with all the applicable standards of ANSI, NEC, ISO, U.L., IEEE and NEMA. The equipment shall meet the requirements of NEC and all applicable codes and regulation.

The generator will be Standby rated at 700 kW, 875 KVA, 1,800 RPM, at 0.8 power factor, 480VAC, 3 phase, 4 wire, 60 hertz, 480/277VAC, wyes connected to a high resistance grounded system, including radiator fan and all parasitic loads. The diesel generator will have auto-sync capabilities.

The emergency diesel generator will be installed in a dedicated area in the combined-cycle area of the plant site and will include the following major components:

- Diesel Engine,
- Governor,
- Lubricating System,
- Generator,
- Exciter,
- Voltage Regulator,
- Remote Synchronizing Panel, including protective relaying and metering,
- Generator Mounted Control Panel,
- Cooling System,
- Fuel System - Fuel Piping and 24 hours Fuel Tank,
- Exhaust System,
- Starting System including Batteries and Batteries Charger, and
- Weather Protective Enclosure.

Emergency Generator Operation Description. The plant critical or essential auxiliary electric loads will be served by the normal plant auxiliary power system at 480V or less, except when the normal source of power is interrupted or in the case of complete power shutdown at the plant. The emergency generator power system and the critical equipment system will be designed and arranged such that in the event of failure of the normal auxiliary power, the emergency diesel generator will be automatically connected within 10 seconds to the essential loads and the switching devices (time delay or non-automatic) that are supplying the critical/essential loads.

When the normal plant auxiliary power source is restored, and after a time delay, the automatic transfer switch will disconnect the emergency power source and connect the load to the normal power source. The emergency diesel generator will be periodically tested to confirm it’s mechanical, electrical and control equipment integrity. The emergency generator system will be synchronized with the normal auxiliary power system from time to time to test its total output power into the system.

2.4.5 Plant Auxiliary Systems and Process Descriptions

The following subsections describe the various plant auxiliary systems (fuel supply, water supply, water treatment, cooling systems, air emissions control, waste management, etc.) associated with the PHPP.

2.4.5.1 Fuel Supply and Use

The CTGs and duct burners are designed to burn natural gas. The fuel requirement for base load operation at average ambient conditions is approximately 69.1 MMscfd. The fuel requirement for peaking operation at 77°F/40%RH ambient conditions is approximately 87.5 MMscfd without solar and 78.3 MMscfd with full solar.

The Project will be fueled with natural gas delivered via a new 20-inch gas pipeline to be installed by Sothern California Gas. Natural gas for the duct burner systems branches off and is regulated to a lower pressure. Safety pressure relief valves are provided downstream of pressure regulation valves. The CTG systems include a natural gas preheater and flow modulation equipment. The duct burner systems also have flow modulation equipment. Table 2-4 shows the typical composition of the natural gas that will fuel the PHPP.

Table 2-4 Typical Natural Gas Composition

Component	Molar % Average
Methane, CH_4	96.26
Ethane, C_2H_6	1.69
Propane, C_3H_8	0.36
Butane, C_4H_{10}	0.06
Pentane, C_5H_{12}	0.01
Hexane, C_6H_{14}	0.02
Carbon Dioxide, CO_2	1.20
Nitrogen, N_2	0.32
Isobutane, CH10	0.01
Isopentane, C5H12	0.02
Total	**100.00**
Specific Gravity	0.582
BTU (Higher Heating Value)	1022
Natural Gas Ratio (HHV/LHV)	1.109

2.4.5.2 Water Supply and Use

The PHPP's various water uses include makeup for the circulating water system, makeup for the HRSGs, water for solar collector mirror washing, makeup for the CTG evaporative coolers, service water, potable

water and fire protection water. A water balance diagram corresponding to base load operation of the power plant at the average ambient conditions of 70°F and 40 percent relative humidity is presented in Figure 2-11a. A similar diagram corresponding to peak load operation with duct burners on and the solar system off is presented in Figure 2-11b, while Figure 2-11c shows peak load operation with the solar system on and the duct burners turned down.

Water Requirements. Figures 2-11a, 2-11b, and 2-11c provide estimated flow rates in gallons per minute (gpm). The estimated daily rate requirements for the power plant's various water uses are presented in Table 2-5. The estimated maximum annual process water requirements are also presented in Table 2-5, based on an upper bound 95 percent capacity factor. Equipment sizing will be consistent with peak daily rates to ensure adequate design margin.

The peak daily process and cooling water usage is estimated at approximately 3.5 million gallons per day. Included in the annual maximum process water use estimate of 3,150 acre feet (AF) is an average yearly water demand of 46 AF for mirror washing. This water load is essentially level throughout the year.

Table 2-5 Daily and Annual Water Uses

Water Use	Average Maximum Daily Rate (gpm)	Peak Daily Rate (gpm)	Estimated Maximum Annual Use (Acre-Feet)
Process and cooling water	2,603	2,965	3,150
Potable water	2.2	3.8	3.6

Primary Water Source and Quality. PHPP process and cooling water needs will be met by use of reclaimed water supplied by the Palmdale WRP. The small quantity of potable water required by the Project (for human use for drinking, toilets, washing, etc.) will be provided by the Los Angeles County Waterworks District No. 40. Both agencies have provided Will Serve Letters, which are provided in AFC Appendix E. An onsite raw water storage tank with a capacity of 1,000,000 gallons will hold 750,000 gallons of reclaimed water for plant operations (sufficient to cover a four-hour interruption of water supply to the facility), plus 250,000 gallons of reclaimed water dedicated to the plant's fire protection water system. The anticipated quality of reclaimed water that will be supplied by the PWRP is shown in Table 2-6. The PWRP currently treats water to secondary standards but is modifying its facility to produce tertiary-treated (reclaimed) water. The information provided in Table 2-6 is from the Victor Valley Water Reclamation Authority (VVWRA_ treatment plant in Victorville, which currently produces reclaimed water (and is expanding its production capability), and which will supply reclaimed water for cooling to the Victorville 2 Hybrid Power Project, a similar facility to the PHPP that was licensed by the CEC in July 2008. The data was obtained from the Victor Valley Water District (VVWD) website and the VVWRA values are presented as "typical". Given that the PWRP will employ the latest tertiary water treatment technology and equipment, the water quality from the PWRP is expected to be similar to that shown in Table 2-6.

Table 2-6 Expected Palmdale Water Reclamation Plant Reclaimed Water Quality Data1

Water Quality Parameter	Average Concentration
Total Dissolved Solids	~5310 mg/l
Total Suspended Solids	~350 mg/l
[1] Based on data from the VVWRA treatment plant in Victorville, California	

Backup Water Source. In addition to the reserve volume of water provided by onsite tank storage, the Project will have a backup water source in the event of a more extended outage in the City of Palmdale's reclaimed water supply system. This backup source will also be reclaimed water. A planned regional reclaimed water backbone system, linking the City of Palmdale with the City of Lancaster is scheduled to be completed in 2013, which is when the PHPP is expected to begin commercial operation. As both the Palmdale and Lancaster treatment plants will be producing reclaimed water, reclaimed water produced by the Lancaster plant will be able to supply the Project in the event of an extended outage of the Palmdale plant's reclaimed water production system.

Water Treatment. The base load and peak-load water-balance diagrams presented in Figures 2-11a, 2-11b, and 2-11c show the power plant's various water uses and water treatment processes. The circulating water, HRSG makeup, and CTG evaporative cooler makeup (described in the following subsections) all require onsite treatment; the treatment varies according to the quality required for each of these uses. The service water, potable water and fire protection water does not require onsite treatment. The following paragraphs describe the PHPP's water treatment processes.

The incoming water from the PWRP is treated with a biocide (sodium hypochlorite) prior to storage in the 1,000,000-gallon onsite tank that will store reclaimed water. The water is used as feed water for the CTG inlet air evaporative coolers without further treatment and used as make-up water in the cooling towers following pH adjustment with sulfuric acid.

The second treatment process treats cooling tower blowdown. The blowdown water is treated with sodium bisulfite and sodium hydroxide for removal of residual chlorine and pH adjustment prior to treatment in a Weak Acid Cation exchanger to remove residual hardness. The water stream is again pH adjusted with sulfuric acid. The water is then stripped of carbon dioxide in a "decarbonator". The decarbonator is simply a packed tower that uses air to strip carbon dioxide from the water stream. The water stream is pH adjusted with sodium hydroxide and sent to the High Efficiency Reverse Osmosis (HERO) unit. The permeate (product) from the HERO unit is either returned to the reclaimed water storage tank for reuse or sent to the HRSG demineralizer for further treatment (see additional details below). The concentrate (reject) from the HERO unit is sent to the brine storage tank for storage pending further processing in the crystallizer unit (see additional details below).

The gravity filter is periodically cleaned by backwashing with clean water; the wash water is returned to the clarifier for further treatment. The Weak Acid Cation exchanger is periodically regenerated with strong acid; the regenerant is sent to the cooling tower. A 1,000,000-gallon surge tank is provided for storage of cooling water blowdown in the event of a service interruption of the treatment process or storage of brine

in the event of a service interruption of the crystallizer process. Any blowdown or brine collected in the surge tank would be sent to the treatment process once the process was returned to service.

The crystallizer treats the brine from the HERO unit to remove the dissolved salts. First, the brine is pH adjusted with sulfuric acid and sent through a series of heat exchangers to raise the temperature of the brine stream. The brine is then sent to a crystallizer where the water is flash evaporated and recovered as “distilled” water, and the solids are collected in slurry. Solids are removed from the slurry using a plate and frame filter press; the water phase is recirculated to the heat exchangers and crystallizer. The recovered water is either returned to the reclaimed water storage tank for reuse or sent to the demineralizer for further treatment as HRSG makeup water (see additional details below).

Circulating Water Treatment. Makeup water for the circulating water system is supplied from the raw water storage tank. Water conditioning chemicals may be fed into the makeup water to minimize corrosion and to inhibit mineral scale formation and biofouling. Sulfuric acid is fed into the circulating water system for alkalinity reduction in order to control the mineral scaling tendency of the circulating water. The sulfuric acid is fed in an amount proportional to the circulating water makeup flow. The sulfuric acid feed equipment includes a bulk storage tank and two full-capacity metering pumps.

To further inhibit mineral scale formation, an organic phosphate inhibitor solution may be fed into the circulating water system in an amount proportional to the circulating water blowdown flow. The inhibitor solution feed equipment includes a bulk storage tank and two full-capacity metering pumps.

To inhibit biofouling, sodium hypochlorite is shock-fed into the circulating water system as a biocide. The sodium hypochlorite feed equipment includes a bulk storage tank and two full capacity metering pumps.

HRSG Makeup Water. Makeup water for the HRSGs must meet stringent specifications for suspended and dissolved solids. To meet these specifications, water from either the HERO or the crystallizer (or both) is processed through a demineralizer process. The water is processed through polishing Reverse Osmosis (RO) unit followed by ion exchange in a cartridge type (bottle) mixed bed ion exchange system. The ion exchange system will be provided by a contract service; once spent, the ion exchange resin cartridges are exchanged with fresh resin cartridges and the spent cartridges taken offsite for regeneration by others. Demineralized product water is stored in a 200,000-gallon condensate storage tank. The RO concentrate is collected in the reclaimed water storage tank for reuse.

Additional conditioning of the condensate and feedwater circulating in the steam cycle is provided by means of a chemical feed system. To minimize corrosion, an oxygen scavenger for dissolved oxygen control and an alkaline solution for pH control are fed into the condensate. To minimize scale formation in the HRSG evaporators and drums, a solution of disodium phosphate (DSP) and trisodium phosphate (TSP) is fed into each feedwater system. The chemical feed system includes an oxygen scavenger feed tank, an alkaline solution feed tank, and a phosphate solution feed tank for each feedwater system. Each of the feed tanks is provided with two full-capacity metering pumps.

A steam cycle sampling and analysis system monitors the water quality at various points in the plant’s steam cycle. The water quality data is used to guide adjustments in water treatment processes and to determine the need for other corrective operational or maintenance measures. Steam and water samples are routed to a sample panel where steam samples are condensed and the pressure and temperature of

all samples are reduced as necessary. The samples are then directed to automatic analyzers for continuous monitoring of conductivity and pH. All monitored values are indicated at the sample panel and critical values are transmitted to the plant control room. Grab samples are periodically obtained at the sample panel for chemical analyses that provide information on a range of water quality parameters.

Solar Mirror Washing Water. To facilitate dust and contaminant removal, deionized water is used to spray clean the solar mirrors on a periodic basis, with frequency determined by the reflectivity monitoring program which identifies when cleaning is needed. This operation is generally done at night and involves a water truck spraying deionized water on the mirrors in a drive-by fashion. The deionized water production facilities, already in place for HRSG makeup water, will be sized to accommodate the additional solar mirror washing demand of 46 acre-feet per year, which is shown on the water balance diagrams. Rinsate from the washing operation is expected to evaporate on the mirror surface with no appreciable runoff.

2.4.5.3 Cooling Systems

The power plant includes two cooling systems; 1) the steam cycle heat rejection system (e.g., cooling tower) and 2) the closed cooling water system (equipment cooling), each of which is discussed below

Steam Cycle Heat Rejection System. The cooling system for heat rejection from the steam cycle consists of a surface condenser, circulating water system and a wet cooling tower. The surface condenser receives exhaust steam from the LP section of the STG and condenses it to liquid for return to the HRSGs. The surface condenser is a shell-and-tube heat exchanger with wet, saturated steam condensing on the shell side and circulating water flowing through the tubes to provide cooling.

The shell side of the condenser is designed to operate under a vacuum. For example, during base load (unfired) operation at average ambient conditions (77°F/40 percent RH), the condenser is expected to operate at pressure of 1.80 in HgA. Under these conditions, the condenser duty is approximately 975 MMBtu/hr. The auxiliary cooling water system contributes 60 MMBtu/hr of that total duty. This heat is absorbed by the circulating water from the tower, which warms by approximately 17°F (27°F at peak load). The warmed circulating water exits the condenser and flows to the cooling tower.

The circulating water is distributed among multiple cells of the cooling tower, where it cascades downward through each cell and then collects in the cooling tower basin. The mechanical draft cooling tower employs electric motor-driven fans to move air through each cooling tower cell. The cascading circulating water is partially evaporated and the evaporated water is dispersed to the atmosphere as part of the moist air leaving each cooling tower cell. As discussed in Sections 5.2, Air Quality and 5.15, Visual Resources, because of climatic conditions at the site, visible moisture plumes are expected to occur relatively infrequently and largely in winter months. The Project may require a plume-abated cooling tower, but no final decision has been made at this time.

The circulating water is cooled primarily through its partial evaporation and secondarily through heat transfer with the air. The cooled circulating water is pumped from the cooling tower basin back to the condenser.

Closed Cooling Water System. The closed cooling water system is filled with a coolant such as a mixture of glycol and water. This coolant is pumped in a closed loop for the purpose of cooling equipment including - the CTG and STG lubrication oil coolers, the CTG and STG generator coolers, the air compressor aftercoolers, the steam cycle sample coolers, etc. The coolant picks up heat from the various equipment items being cooled and then the coolant itself is then cooled by non-contact heat exchange with a branch of the circulating water system.

2.4.5.4 Waste Generation and Management

Project wastes include wastewater, non-hazardous solid waste, hazardous solid waste, and hazardous liquid waste. Wastes generated by the PHPP will be collected, managed and disposed in accordance with applicable LORS. Project waste streams and management approaches are also discussed in Section 5.16, Waste Management.

Wastewater. The base load and peak load water balance diagrams show the power plant's wastewater streams and the disposition of wastewater. Wastewater is segregated into two separate collection systems; industrial streams (referred to as the brine system) and sanitary wastes. The brine system collects wastewater from the HRSGs, CTG evaporative coolers, and demineralization system and delivers it to the circulating water system via the cooling tower basin. The Project is a ZLD design meaning that there is no offsite disposal of liquid industrial waste. Cooling tower blowdown is processed in a crystallizer into solids for disposal and the removed water is recycled for use in the cooling system. Based on the Project's expected operating profile, the average total quantity of solid disposal is expected to be approximately 15.5 ft^3 per day.

Wastewater sources for processing include the following:

- Circulating Water System Blowdown,
- HRSG Blowdown,
- CTG Evaporative Cooler Blowdown,
- Demineralization System Wastewater,
- Chemical Feed Area Drains, and
- General Plant Drains.

The Project's sanitary system collects wastewater from sanitary facilities such as sinks and toilets. This waste will be sent to the Los Angeles Sanitation District. The Project's sanitary wastewater pipeline will be sized to accommodate the needs of a small work force (36 people for 24/7 operations), and preliminary engineering indicates a six-inch line will suffice.

Non-Hazardous Solid Waste. The operation and maintenance of the PHPP will generate non-hazardous solid wastes typical of power generation facilities. These wastes include scrap metal, insulation material, paper, glass, empty containers, plastics and other miscellaneous solid wastes. These materials will be disposed of by means of contracted refuse collection and recycling services.

Hazardous Solid and Liquid Waste. Hazardous wastes will be generated during Project construction and operation. Most of the hazardous wastes during the construction phase (e.g., paint and primer,

thinners, solvents) will be recycled. Hazardous solid and liquid waste streams generated during PHPP operations include spent SCR catalyst; used hydraulic fluids, oils, greases, filters, etc.; spent cleaning solutions and spent batteries. To the extent possible, operation phase hazardous wastes will be recycled. Section 5.16, Waste Management summarizes the Project's hazardous and non-hazardous waste streams in terms of quantities, origin and composition and management method(s).

2.4.5.5 Hazardous Materials Management

There will be a variety of hazardous materials used and stored during construction and operation of the PHPP. Section 5.6, Hazardous Materials Handling provides additional data on the hazardous materials that will be used during construction and operation, including quantities, associated hazards and permissible exposure limits, storage methods and special handling precautions.

All hazardous materials will be stored onsite in storage tanks or vessels that are specifically designed for the characteristics of the materials to be stored. The storage facilities will include the needed secondary containment in case of tank/vessel failure.

Hazardous materials that will be used during construction include gasoline, diesel fuel, oil, lubricants and small quantities of solvents and paints. During operation, hazardous materials that will be stored and used onsite include aqueous ammonia for the SCR system (aqueous ammonia is a dilute solution of less than 20 percent ammonia, with the balance water). A 30,000-gallon carbon steel aqueous ammonia storage tank will be provided with a containment basin draining to a covered collection sump. The collection sump will be sized to contain the entire contents of the storage tank.

Carbon steel tanks also will be used to store sodium hydroxide solution (7,500-gallon capacity), sulfuric acid (10,000-gallon capacity), lube oil and diesel fuel (largest tank is 1,200 gallons). Carbon steel or fiberglass tanks will be used to store magnesium chloride (10,000-gallon tank). Secondary containment will be provided for the tank.

A variety of safety-related plans and programs will be developed and implemented to ensure safe handling, storage, and use of hazardous materials (e.g., Risk Management Program and Hazardous Material Business Plan). Plant personnel will be supplied with appropriate personal protective equipment (PPE) and will be properly trained in the use of PPE. Additional training will include the handling, use and cleanup of hazardous materials used at the facility, as well as procedures to be followed in the event of a leak or spill. Adequate supplies of appropriate cleanup materials will be stored onsite.

2.4.5.6 Air Emissions Control and Monitoring

Air emissions from the combustion of natural gas in the CTGs and duct burners are controlled by state-of-the-art systems. Emissions that are controlled include nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), fine particulate matter (PM10) and sulfur dioxide (SO_2). Continuous emissions monitoring is performed to ensure that the control systems perform correctly and to provide compliance documentation. All emissions values stated in the following subsections are based on parts per million by volume, dry basis (ppmvd) corrected to 15 percent oxygen (O_2). A summary of emission rates from the combined-cycle equipment is shown in Table 2-7. A brief description of planned air emissions control methods is provided in the following paragraphs.

Table 2-7 Combined-Cycle Emission Rates

Pollutant	Load Range % of GT Base	Ambient Temperature Range ºF	Duct Burner Status	Emission Rate
NO_x Emissions, ppmvd, Ref. 15 % O_2	50 to 100 55 to 100	18-105 105-112	Off Off	2 ppmvd 2 ppmvd
NO_x Emissions, ppmvd, Ref. 15 % O_2	Base	18-112	On	2 ppmvd
NH_3 Emissions, ppmvd, Ref. 15 % O_2	50 to 100 55 to 100	18-105 105-112	Off Off	5 ppmvd 5 ppmvd
NH_3 Emissions, ppmvd, Ref. 15 % O_2	Base	18-112	On	5 ppmvd
CO Emissions, ppmvd, Ref. 15 % O_2	50 to 100 55 to 100	18-105 105-112	Off Off	2 ppmvd 2 ppmvd
CO Emissions, ppmvd, Ref. 15 % O_2	Base	18-112	On	3 ppmvd
VOC Emissions, ppmvd Ref.15% O_2 as CH_4	50 to 100 55 to 100	18-105 105-112	Off Off	1.4 ppmvd 1.4 ppmvd
VOC Emissions, ppmvd Ref.15% O_2 as CH_4	Base	18-112	On	2 ppmvd
Total PM10 lb/hr per Stack	50 to 100 55 to 100	18-105 105-112	Off Off	12 lb/hr
Total PM10 lb/hr per Stack	Base	18-112	On	18 lb/hr

Nitrogen Oxides Emissions Control. Stack emissions of NO_x will be controlled by use of dry low-NO_x (DLN) combustors in the CTGs followed by selective catalytic reduction (SCR) in the HRSGs. The DLN combustors control NO_x emissions at the CTG exhausts by pre-mixing fuel and air immediately prior to combustion. Pre-mixing inhibits NO_x formation by minimizing both the flame temperature and the concentration of oxygen at the flame front.

The SCR process uses aqueous ammonia (NH_4OH) as a reagent. Stack emissions of ammonia, referred to as 'ammonia slip,' are up to 10 ppmvd. The SCR system includes a catalyst bed located within each HRSG, an ammonia storage system and an ammonia injection system. The catalyst bed is located in a temperature zone of the HRSG where the catalyst is most effective over the range of loads at which the plant will operate. The ammonia injection grid is located upstream of the catalyst bed. The plant ammonia consumption rate is approximately 266 lb/hr at base load (77ºF/40% RH unfired) conditions and 571 lb/hr at maximum load (18ºF/60% RH fired). A 30,000-gallon aqueous ammonia storage tank located on the PHPP plant site will provide sufficient capacity for more than 14 days of continuous operation.

Other Criteria Pollutant Emissions Control. An oxidation catalyst located within each HRSG controls stack emissions of CO. The oxidation catalyst also reduces stack emissions of VOC.

Fine particulate (particulate matter smaller than 10 microns in size, referred to as PM10) emissions are controlled by inlet air filtration and by the use of natural gas fuel, which contains essentially zero particulate matter. Stack emissions of PM10 consist primarily of hydrocarbon particles formed during combustion. Sulfur dioxide emissions are controlled by the use of natural gas fuel, which contains only trace quantities of sulfur.

Continuous Emissions Monitoring System (CEMS). The Project's CEMS will be in a self enclosed, climate controlled enclosure and will sample, analyze and record NO_x, CO, and O_2 concentrations in the stack exhaust. The CEMS will generate a log of emissions data for compliance documentation and activate an alarm in the plant control room when stack emissions exceed specified limits.

2.4.5.7 Fire Protection

Fire protection systems are provided to limit personnel injury, property loss, and Project downtime resulting from a fire. The systems include a fire protection water system, carbon dioxide fire suppression systems for the CTGs and portable fire extinguishers.

The PHPP's fire protection water system will be supplied from a dedicated 250,000-gallon portion of the 1,000,000-gallon raw water storage tank located on the Project site. One diesel-driven fire pump, with a capacity of 500 gallons per minute will deliver water to the fire protection water-piping network. A second electric motor-driven pump (a small capacity jockey pump) will maintain pressure in the piping network. If the jockey pump is unable to maintain a set operating pressure in the piping network, the fire pump starts automatically.

The piping network will be configured in a loop so that a piping failure can be isolated with shutoff valves without interrupting the supply of water to a majority of the loop. The piping network will supply fire hydrants located at intervals throughout the power plant site, a sprinkler deluge system at each unit transformer and a sprinkler system in the operations building.

The carbon dioxide (CO_2) fire suppression system provided for each CTG will include a CO_2 storage tank, CO_2 piping and nozzles, fire detection sensors and a control system. Upon detection and automated confirmation of the existence of a fire, the control system will automatically shut down the CTG, turn off ventilation fans, close ventilation openings and release CO_2. The CO_2 fire suppression systems will cover the turbine and accessory equipment enclosures of each CTG. Portable fire extinguishers of appropriate sizes and types will be located throughout the plant site.

Fire protection for the solar field will be provided by zoned isolation of the HTF lines in the event of a rupture that results in fire. The HTF will be allowed to extinguish itself naturally, since the remainder of the field is of nonflammable material (aluminum, steel, and glass).

2.4.5.8 Plant Auxiliary Systems

The following plant auxiliary systems control, protect and support the Project and its operation.

Distributed Control System. The Distributed Control System (DCS) provides control, monitoring, alarm and data storage functions for power plant systems. These include:

- Control of the CTGs, STG, HRSGs and balance-of-plant systems in a coordinated manner,
- Monitoring of operating parameters from plant systems and equipment,
- Visual display of the associated operating data to control operators and technician
- Detection of abnormal operating parameters and parameter trends and provision of visual and audible alarms to apprise control operators of such conditions, and
- Storage and retrieval of historical operating data.

The DCS is a Mark VIe - expandable microprocessor-based system. Redundant capability is provided for critical DCS components, such that no single component failure will cause a plant outage. The DCS consists of the following major components:

- Flat Panel-based control operator interface (redundant),
- Flat Panel-based control technician work station,
- Multi-function and expandable processors (redundant),
- Input/output processors (redundant for critical control parameters),
- Field sensors and distributed processors (redundant for critical control parameters),
- Historical data archive, and
- Printers, data highways, data links, control cabling and cable trays.

The DCS is linked to the control systems furnished by the CTG and STG supplier. These data links provide CTG and STG control, monitoring, alarm and data storage functions via the Flat Panel based control operator interface and control technician workstation of the DCS. The DCS will provide Automatic Generation Control (AGC) and Remote Interface Gateway (switchyard control) for CAISO.

Lighting System. The Project's lighting system will provide operations and maintenance personnel with illumination in both normal and emergency conditions. The system will consist primarily of AC lighting, but will include DC lighting for activities or emergency egress required during an outage of the plant's AC electrical system. The lighting system also will provide AC convenience outlets for portable lamps and tools. Lighting will be designed to provide the minimum illumination needed to achieve safety and security objectives and will be shielded and oriented to focus illumination on the desired areas and minimize additional nighttime illumination in the site vicinity.

Cathodic and Freeze Protection Systems. Cathodic protection systems protect against electrochemical corrosion of underground metal piping and structures. Underground metal structures of the Project will have cathodic protection.

Freeze protection systems are not needed for the combined-cycle equipment because of the infrequency and short duration of below-freezing ambient temperatures at the Project site. However, due to the high freezing temperature of the solar field's HTF (54°F), a 40 MMBtu/hr gas-fired HTF heater will be provided

to protect the system during the night hours and colder months. Expected gas usages for this heater are presented in Table 2-8.

Table 2-8 HTF Heater Gas Usage Estimates

Month	Cumulative Usage
November	7,500 MCF
December	10,000 MCF
January	10,000 MCF
February	7,500 MCF
All Other Months	5,000 MCF

Service Air and Instrument Air Systems. The service air system supplies compressed air to hose connections located at intervals throughout the power plant. Compressors deliver compressed air at a regulated pressure to the service air-piping network.

The instrument air system provides dry, filtered air to pneumatic operators and devices throughout the power plant. Air from the service air system is dried, filtered, and pressure regulated prior to delivery to the instrument air-piping network.

2.4.6 Project Civil/Structural Features

The following subsections describe civil/structural features of the Project, as illustrated in the General Arrangement/Site (Figure 2-4) and the General Arrangement Power Block (Figure 2-5). The power plant will be designed in conformance with Uniform Building Code criteria for Seismic Zone 4.

2.4.6.1 CTGs, HRSGs, STG, and Associated Equipment

The CTGs, HRSGs, STG, and condenser will be located outdoors and supported on reinforced concrete mat foundations. The STG foundation will include a reinforced concrete pedestal that supports the STG above the surface condenser. The three step-up transformers and two auxiliary transformers also will be supported on reinforced concrete mat foundations. Balance-of-plant (BOP) mechanical and electrical equipment will be supported on individual reinforced concrete pads. BOP components/materials include piping, valves, cables, switches, etc. that are not included with major equipment and are generally installed or erected onsite.

2.4.6.2 HRSG Stacks

Each of the two HRSGs will have with a self-supporting steel stack. The stacks will be 18.5 feet in diameter and 145 feet tall. The stacks include sampling ports, ladders, platforms, and electrical grounding.

2.4.6.3 Solar Array Support Structures

Each solar collector array will be supported by structures (stands) that connect the parabolic troughs to the pointing mechanism. Each stand will be approximately nine feet tall and supported by individual foundations. Foundation design will be based on site-specific geotechnical conditions to ensure that the solar array stands are able to support all loading conditions (including wind loading) at the Project site.

2.4.6.4 Buildings

The Project operations building will incorporate control, maintenance and administrative functions. The design and construction of the operations building will be consistent with normal building standards. Other onsite "buildings" will include the water treatment building, as well as a number of pre-engineered enclosures for mechanical and electrical equipment (e.g., fire pump building, sample analysis building, and switchyard module). Building columns are supported on reinforced concrete mat foundations or individual spread footings and the structures rest on reinforced concrete slabs. The total square footage of the various Project buildings and pre-engineered enclosures is approximately 36,500 square feet.

2.4.6.5 Water Storage Tanks

There will be a number of covered water tanks onsite including a 1,000,000-gallon raw water storage tank for short-term backup cooling water supply, with a portion (250,000 gallons) dedicated to the plant's fire protection water system. There also will be a 200,000-gallon storage tank for storage of demineralized water. Water storage tanks will be vertical, cylindrical, field-erected steel tanks supported on foundations consisting of either a reinforced concrete mat or a reinforced concrete ring wall with an interior bearing layer of compacted sand supporting the tank bottom. Additionally there will be a 1,000,000-gallon process surge tank capable of receiving flow from the brine storage tank and the cooling tower blowdown basin to allow for process startup/shutdown and interruption.

2.4.6.6 Roads and Fencing

As noted earlier, the PHPP site is located west of the Northwest corner of Air Force Plant 42, near the intersection of Sierra Hwy and E Ave M. The main access to the site during construction and operation will be via a new street and signalized intersection at 10th Street developed by the City.

Only a small portion of the overall Project site will be paved with asphalt, primarily in the power block, where there will be a paved parking lot and roads encircling the turbine-generator and HRSG areas. The remaining portions of the power block will be gravel surfaced. In total, the power block will be approximately 19 acres with approximately five acres of paved area. The solar field will remain unpaved and without a gravel surface in order to prevent rock damage from wash vehicle traffic. The asphalt-paved roads will have two 12-foot wide lanes and a 5-foot wide shoulder on each side. Unpaved ground surfaces in and around the main equipment area of the power block will be covered with crushed stone or gravel.

The PHPP plant site will be secured with eight-foot tall security fencing, with barbed wire or razor wire on top. Fencing will enclose the entire site including the storm water basin and the solar field. Additionally, desert-style landscaping is expected to be used to enhance the facility's appearance. The plant site's eastern fence line and southern fence lines will not receive landscaping in order to accommodate the

security requirements of Air Force Plant 42. The remaining perimeter will include aesthetic landscaping. The landscaping will be limited to drought-tolerant plants; the central element will be Joshua trees presently occupying the plant site that will be transplanted to locations along the site perimeter (see Conceptual landscaping Plan in Section 5.17, Visual Resources).

Controlled access gates will be located at the site entrance. Within the site, chain-link security fencing will be provided around the switchyard. Access to the PHPP plant site will be controlled through a security gate located on the west side of the proposed power block at the entrance drive.

2.4.6.7 Site Drainage

Existing site topography shows an average slope of one percent toward the north to northeast. At present, the plant site contains only natural swales and natural low ponding areas. There are no drainage ditches or storm drains onsite. There is an irrigation channel along the railroad tracks that runs parallel to the site's western boundary, but with the exception of a number of low spots where ponding occurs, site drainage currently flows towards the north and northeast, while the channel travels along the western edge of the site. Therefore, no water from the plant site enters the irrigation channel.

For purposes of devising the site drainage plan, the PHPP plant site was divided into two sections - north and south. The north section includes the area of solar field north of the access road and roughly the northern half of the power block. The north section drains to the north into an infiltration pond along the northern boundary of the plant site. The south section of the site includes the area of solar field south of the access road and roughly the southern half of the power block area. The South section drains to the infiltration ponds located on the south side of the access road and the south side of the power block area. No storm water runoff discharge will leave the Project site. The majority of the run-on from the neighboring site, west and south west of proposed solar field, will flow north along the west boundary of the solar field and will be collected into a new infiltration pond. The new filtration pond will be located close to the entrance road, at the southwest corner of the intersection of 10th St E and E Ave M.

The PHPP will employ a comprehensive system of management controls, including site-specific Best Management Practices (BMP), to minimize storm water contact with contaminants and thus minimize pollutants in storm water. These management controls, which will be described in the Project's Storm Water Pollution Prevention Plans (SWPPP) and Drainage Erosion and Sediment Control Plan (DESCP) (a preliminary draft DESCP is provided as AFC Appendix L), include:

- Employee Training Program,
- Erosion and Sediment Control,
- Good Housekeeping Programs,
- Preventive Maintenance Programs,
- Structural BMPs,
    - Temporary containments during maintenance activities
    - Permanent secondary containment structures at chemical storage and process areas
- Materials, Equipment and Vehicle Management Practices,

- Spill Prevention and Response Programs, and
- Inspection Programs.

The Project's power block and solar field areas will be graded to allow for a balanced distribution of material, so there is not a requirement to truck large quantities of earth materials to or from the site. The cut and fill grading necessary to create suitable conditions for Project construction will result in an elevation of approximately 2,500 feet amsl. Current estimates are that offsite import or export of soil will not be required,

Adjustments will be made to provide engineered fill as required for stabilization under equipment and structure foundations per the Project geotechnical report. Only soil materials approved by a geotechnical engineer for structural fill will be used. Additionally, specialized granular materials may need to be imported to the proposed site for road base and possible use below foundations.

2.4.6.8 Earthwork

As noted earlier, existing site elevations range from approximately 2,490 feet amsl to 2,555 amsl and the site generally slopes an average of approximately one percent toward the north to northeast. Mass grading of the site will occur at the beginning of the Project construction phase. The solar field area, approximately 250 acres, will be graded to slope gently towards the northeast at a rate of 0.5 percent. The power block area, approximately 20 acres, will be on elevated fill area to avoid flooding during any major rainfall event. Earthwork associated will also include excavation for infiltration ponds, equipment foundations, and underground systems. Current estimates are that no import of soil from offsite locations or export of soil from the plant site will be required.

2.4.7 Pipeline Facilities Description

The following sections describe the PHPP's pipeline facilities and routes.

2.4.7.1 Fuel Gas Supply Line

SCG will construct an 8.7-mile, 20-inch fuel gas supply line to serve the Project. The pipeline will originate at the SCG facility on E Ave S and terminate at the PHPP plant site, as shown on Figure 2-1. The route is completely within the City of Palmdale. It will be installed in existing street ROWs and is mostly within developed areas.

2.4.7.2 Reclaimed Water Supply Line

The City of Palmdale will install a 7.4-mile, 14-inch reclaimed water line from the PWRP to the PHPP plant site to provide water for power plant cooling and other industrial uses, as shown on Figure 2-1. All but a small section of the route near the PWRP is within the City of Palmdale. It will be routed in existing city street ROWs and is within developed areas.

2.4.7.3 Sanitary Wastewater Disposal Line

The Project will install a one-mile, six-inch sanitary wastewater pipeline from the PHPP plant site to a connection point with an existing Los Angeles County Sanitation District 12-inch sewer line. The connection point will be at the intersection of 10 St E and E Ave L, as shown on Figure 2-1.

2.4.8 Project Construction

The planned PHPP construction schedule will last 27 months, with the construction workforce peaking at 767 during Month 12 of the construction schedule; over the entire construction period, there will be an average workforce of approximately 360. The on-site workforce will consist of laborers, craftsmen, supervisory personnel, support personnel, and construction management personnel. Section 5.11, Socioeconomics, provides a breakdown of the construction workforce by skill over the entire construction period.

A 50-acre temporary construction laydown and parking area will be provided, as shown on Figure 2-4. The construction sequence for power plant construction includes the following general steps:

- Site Preparation: this includes detailed construction surveys, grading, and preparation of drainage features. It is expected that the combined-cycle area will be prepared first followed by the solar field.
- Foundations: this includes excavations for large equipment (CTGs, STG, HRSG, etc.) and footings for the solar field. This work will begin in the combined-cycle equipment area and then move to the solar field.
- Major Equipment Installation: once the foundations are complete the larger equipment will be installed. The solar field will be assembled onsite once the foundations are installed.
- Balance of Plant (BOP): with the major equipment in place, the remaining fieldwork will involve piping, electrical, and smaller component installations.
- Testing and Commissioning: testing of subsystems will be done as they are completed. Major equipment will be tested once all supporting subsystems are installed and tested.

Construction of the Project transmission system will begin in the third month of the overall construction schedule with work on Segment 2, which extends between the Pearblossom and Vincent Substations to the south of the plant site. Transmission line construction then will proceed northward to Segment 1. Construction of the various Project pipelines will begin in the seventh month of the construction schedule.

Equipment and materials will be delivered to the Project site by truck; large components (e.g., CTG) will be brought to the Palmdale area by rail and brought to the site by special transporter trucks designed for large loads. Construction will typically take place between the hours of 6 am and 6 pm, Monday through Friday.

2.4.7 Facility Operation

The Project will have a small workforce during operation. Actual power plant operations will be controlled by three to five individuals during each operating shift. Additional maintenance and supervisory

personnel will be present during the day shift and as required by specific operations or maintenance activities, during evening and night shifts. The project is expected to employ 36 full-time personnel.

The power plant will be operated up to 7 days per week, 24 hours per day. When the plant is not operating, personnel will be present as necessary for maintenance, to prepare the plant for startup, and/or for site security. Section 3.0 discusses facility closure, both temporary and permanent at the end of the Project's operational life.

2.5 Transmission System Description

This subsection describes the transmission interconnection between the PHPP and the existing electrical grid. It summarizes the findings of the System Impact Study (SIS) prepared by SCE that addresses the impacts of the Project interconnection on the operation of the region's electrical power grid. It also describes the Projects two transmission line segments and the construction activities that are required for each segment.

SCE (under the direction of the California Independent System Operator or CAISO), completed a System Impact Study (SIS) pursuant to an Interconnection System Impact Study Agreement. The SIS is provided as Appendix F of the AFC. Power load flow diagrams showing conformance with utility reliability and planning criteria are contained in the SIS. Following is a very brief summary of the SIS findings.

The SIS assessed the collective impacts of the projected amounts and types of electrical generation, It identified several transmission segments that must be added to the regional system, so as to reliably deliver the queued generation to the Pardee, Vincent, and Whirlwind Substations and to increase the transfer capacity south of Vincent to accommodate the queued generation.

The SIS discusses these additional planned transmission segments, which increase the "south of Vincent" transfer capacity, and the timing of such increases. The study includes that the transfer capability of the system "south of Vincent":

- Will increase from 1,100 MW to 1,250 MW in March of 2011
- Will increase from 1,250 MW to 2,200 MW in August of 2011
- Will not be sufficient to accommodate all of the queued generation in the Tehachapi area until late 2013.

The proposed interconnection point for the Project with the regional electrical grid is at SCE's existing Vincent Substation, via a new AA 230-kV transformer bank and a new Vincent-Mesa No.2 500/230 kV transmission line. This substation and transmission line upgrade will be part of SCE's Tehachapi Renewable Transmission Project (TRTP) and the Antelope Transmission Project (ATP) regional 2,519 MW grid upgrade, as detailed in the SIS.

SCE has determined that the regional transmission improvements will be available in 2012 to support the PHPP capacity of 570 MW. In addition, SCE has acknowledged the possibility that other projects could fall out of the queue and create additional capacity earlier than the 2012 in-service date. Because the PHPP is scheduled to come online in 2013, adequate transmission capacity will be available to serve the Project.

Photographs of existing conditions at representative locations along the PHPP transmission line route and simulations that show these locations with the addition of the Project transmission lines are provided as Figures 2-12a and -12b (Segment 1) and 2-13a and -13b (Segment 2). In addition to the SIS, an Interconnection Facilities agreement to determine needed Vincent Substation upgrades and/or expansion has been executed with SCE. The study results will be available during the second quarter of 2009.

It is anticipated that the final design and subsequent construction of the transmission facilities and any reliability upgrades will be completed by SCE. Further, it is expected that SCE will likely build, own and operate the 35.6-mile transmission system. The following paragraphs describe the PHPP transmission system and the associated construction activities.

2.5.1 Transmission Line Construction

The PHPP transmission line will be approximately 35.6 miles long and consist of two segments. Segment 1 begins on the PHPP onsite switchyard and extends approximately 23.7 miles through new and existing ROWs to SCE's existing Pearblossom Substation and will involve stringing conductors on new steel poles. Average pole spacing will be approximately 750 feet; pole heights will range from 100 feet to 135 feet. Segment 2 will be approximately 11.9 miles long and the conductors will be strung on new steel poles in the existing SCE ROW between Pearblossom and the Vincent Substation. The route segments are shown on Figure 2-1, which includes mileposts.

Segment 1 proceeds north and east, then south, and finally southwest to join the existing SCE transmission ROW just north of the Pearblossom Substation. Segment 2 proceeds west from that point to the Vincent Substation. As can be seen on Figure 2-1, the route travels through/near a mixture of disturbed and undisturbed areas, which includes desert areas, agricultural properties, industrial and residential areas. Land uses along the route are discussed and illustrated in Section 5.7, Land Use. The process of selecting the transmission line route is addressed in Section 4.0, Alternatives.

Elements of Transmission Line Construction

Road Work: As needed, dirt roads will be cleared for access along the transmission line route to provide access to the pole and tower locations. These access roads will be installed in locations that avoid sensitive environmental resources identified in Project environmental surveys. Because the Segment 1 transmission lines will be installed near existing roadways and because the existing SCE ROW of Segment 2 already has a maintenance road along its length, only short stub roads will be needed to provide access to the individual pole locations. It is assumed that stub roads (average dimensions 50 feet long by 14 feet wide) will be needed for all of the new poles in Segment 1. Because the poles in Segment 2 will be installed in the same locations as existing transmission structures, very few stub roads will be needed in Segment 2.

Foundations: Lattice structures and poles have different foundation requirements. Each pole will have a single foundation installed that will require curing prior to the pole installation. Each lattice will require 4 separate foundations. All foundations will be installed in locations that avoid sensitive environmental resources identified in Project environmental surveys. It is expected that the total area of disturbance at each location for all transmission line installation activities will average 200 feet by 200 feet.

Pole Erection: Each pole, made up of two heavy duty tubular steel sections, will be assembled onsite and welded together. The insulators and conductor hardware will be installed following pole erection.

Conductors: From pulling sites, the conductors will be installed, sagged to specifications and permanently connected to the insulators. The conductor size is 1590 ACSR.

Pulling Sites: Pull sites will be required at a number of locations along both Segments 1 and 2. Most sites will be on existing access roads or access roads that will be installed as part of the transmission line installation.

Communication System: The overhead ground/fiber optic communications (OPGW) cable will be installed using the same pulling sites as were used for the conductor installation.

Cleanup: Although cleanup will be ongoing as the work proceeds, once construction is completed, a final cleanup will occur.

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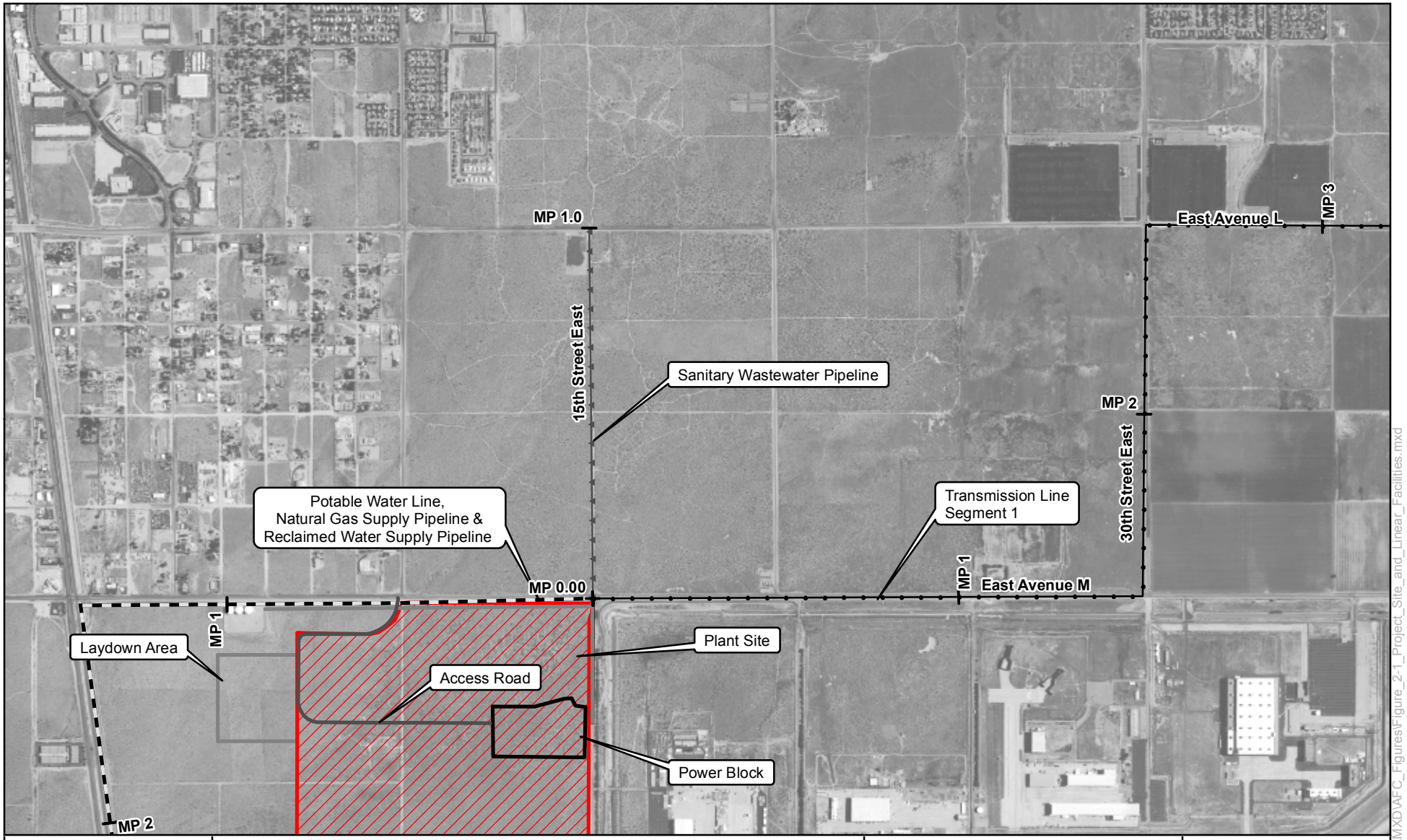

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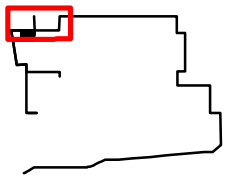

Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 01 of 14

PALMDALE
a place to call home

Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

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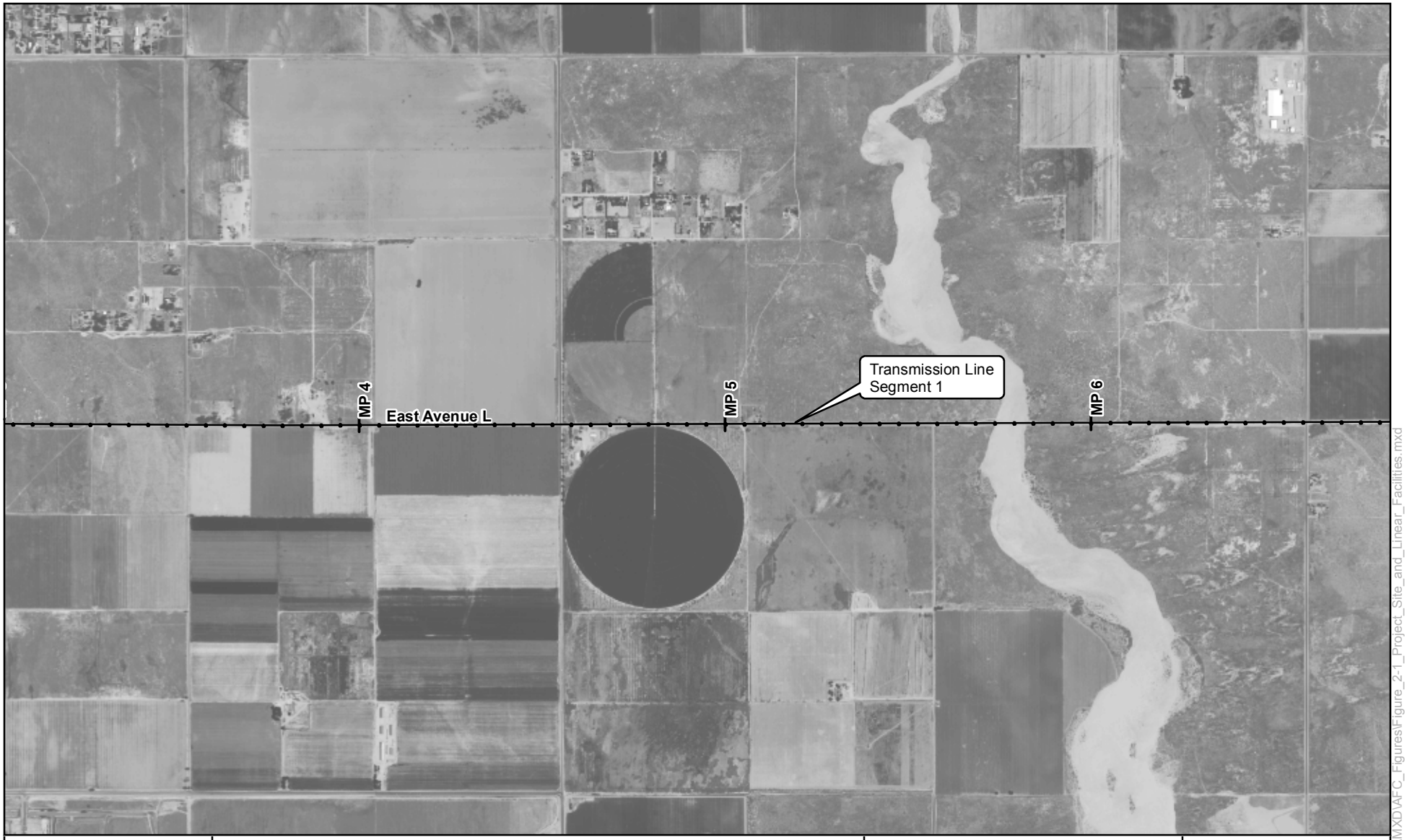

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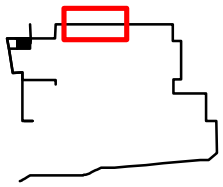

Legend

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- Transmission Line

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Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 02 of 14

PALMDALE
a place to call home

Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

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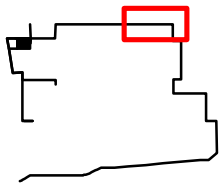
Map Location



Legend

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- Sanitary Wastewater Pipeline
- Transmission Line

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Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 03 of 14

PALMDALE
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Inland Energy, Inc.

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Project: 10855-002
Date: July 2008

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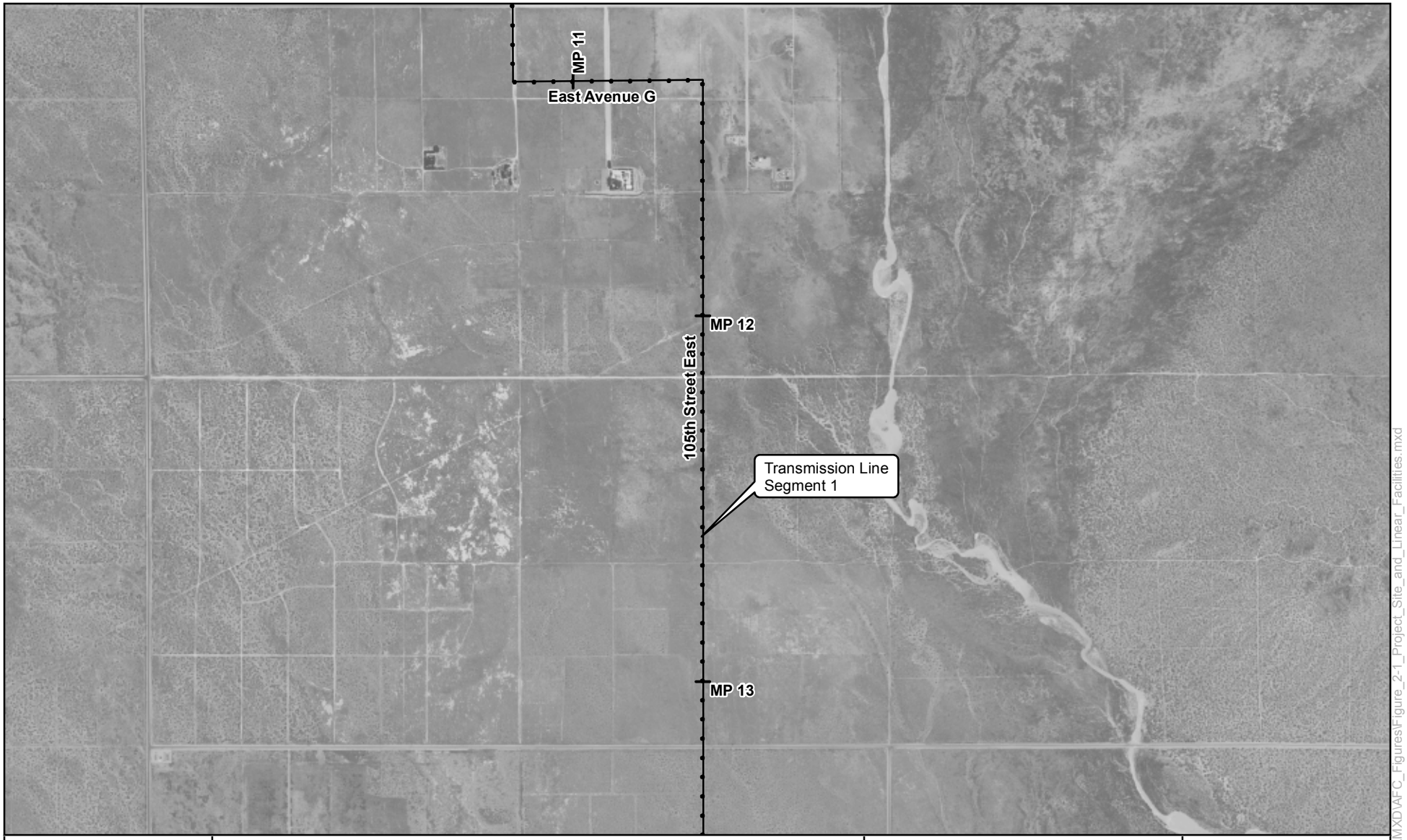

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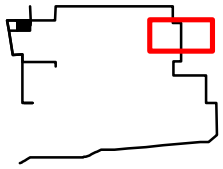

Legend

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- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 04 of 14

PALMDALE
a place to call home

Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
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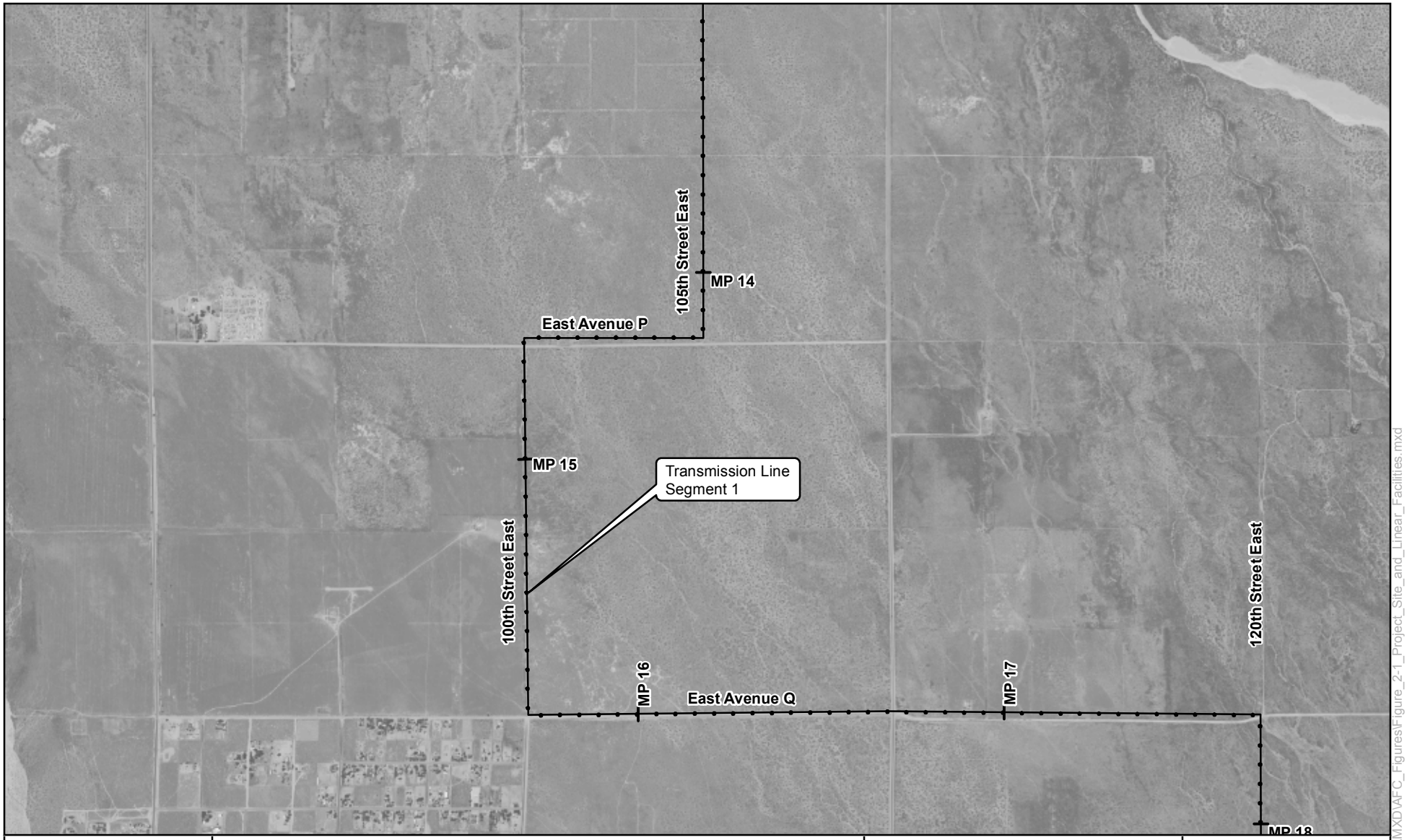

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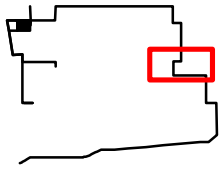

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- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 05 of 14

PALMDALE
a place to call home

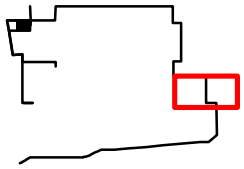
Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd

Map Location



Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 06 of 14

PALMDALE
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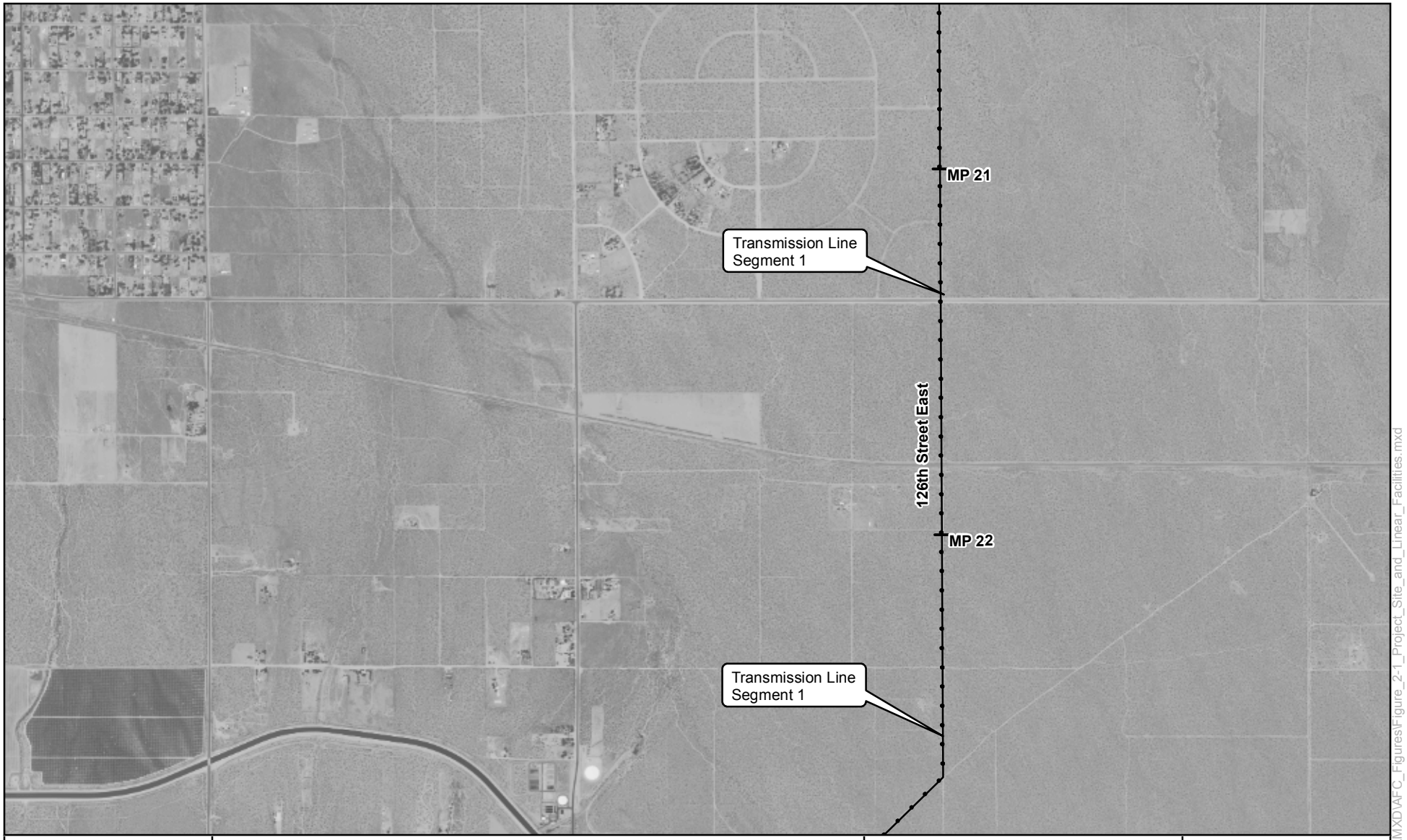
Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd



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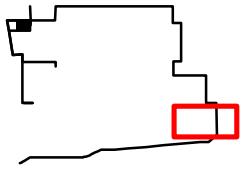

Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 07 of 14

PALMDALE
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Inland Energy, Inc.

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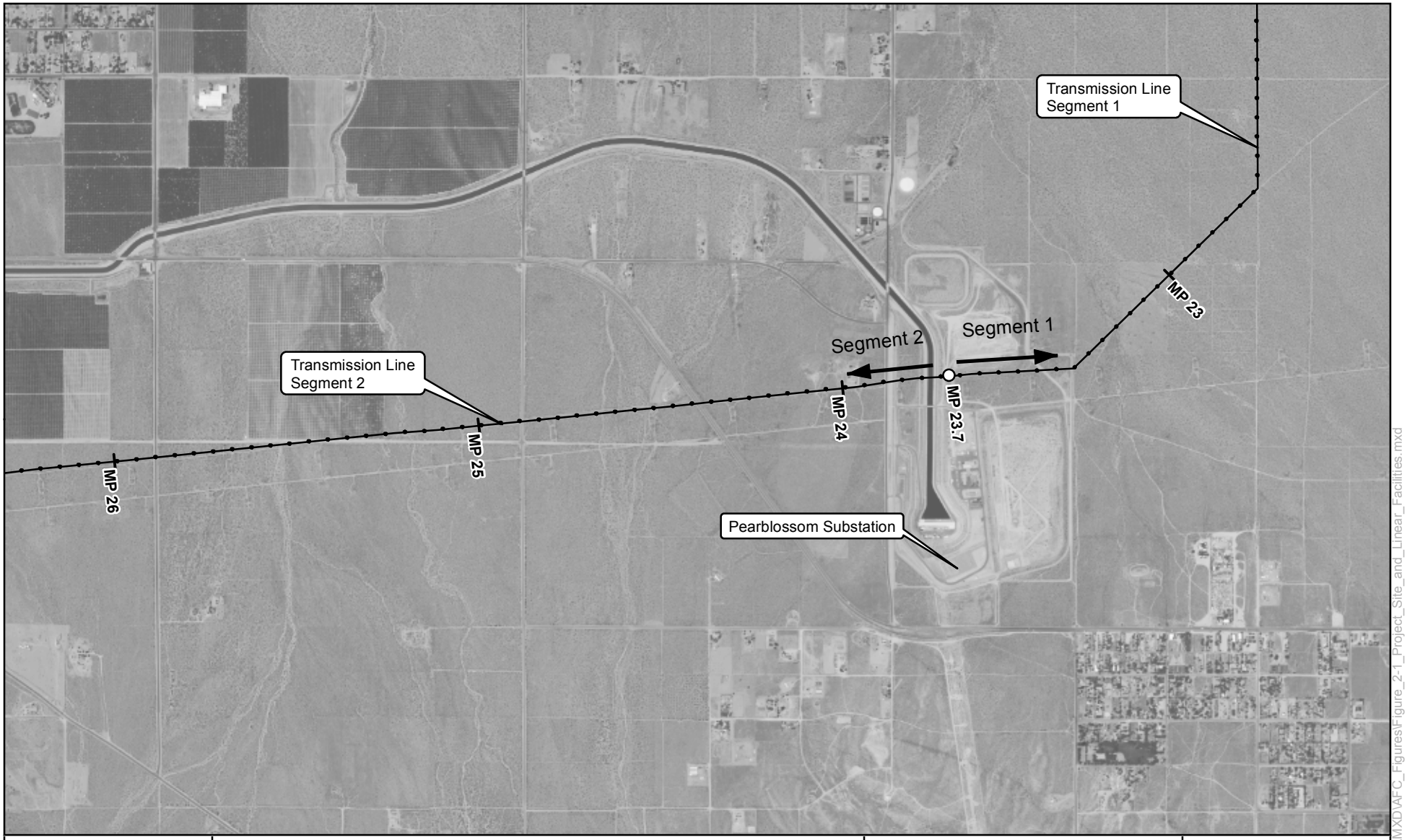
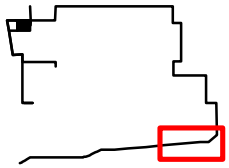
Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd



Map Location



Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 08 of 14

PALMDALE
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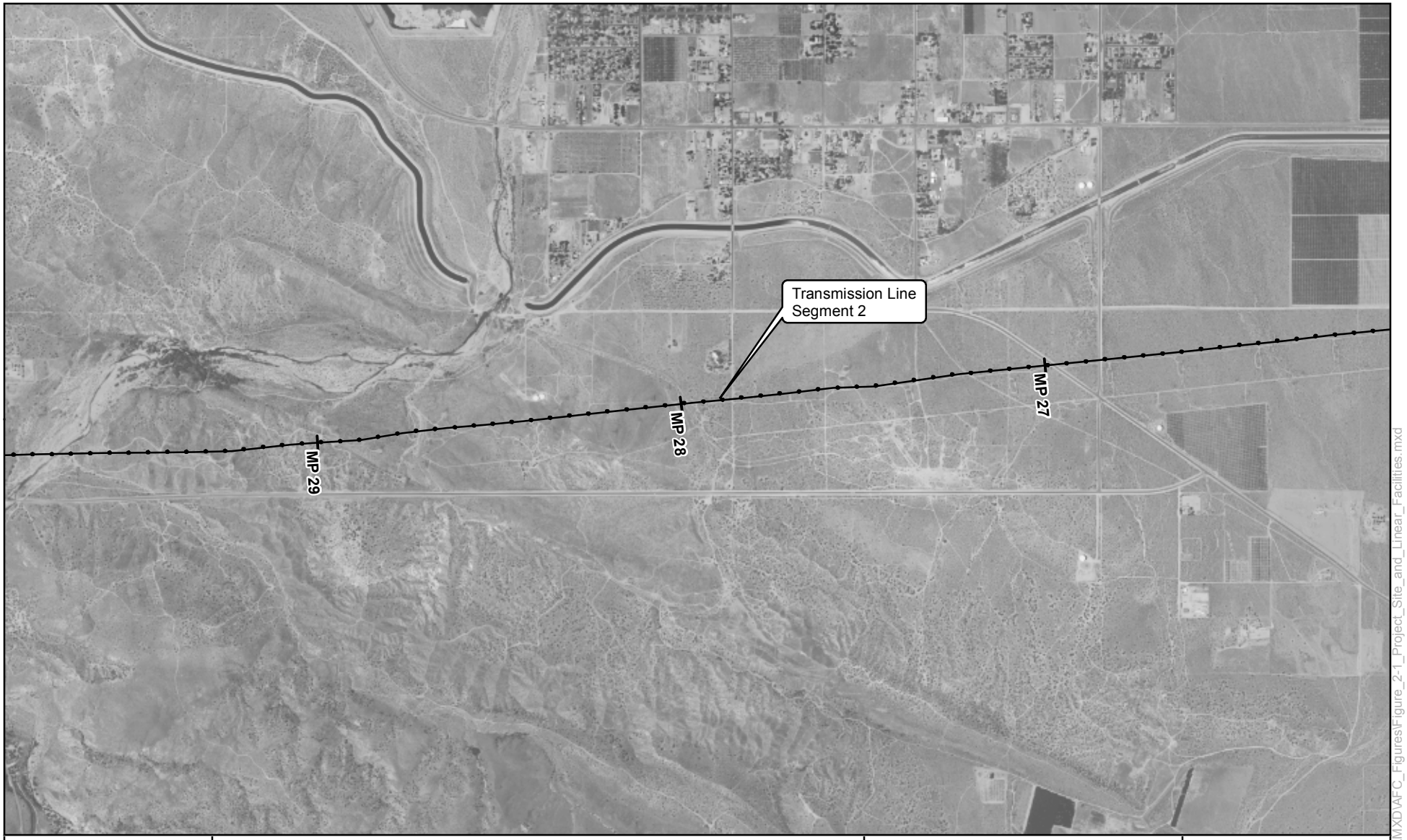
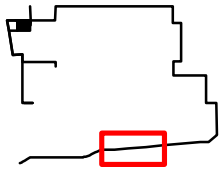
Inland Energy, Inc.
ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd



Map Location



Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 09 of 14

PALMDALE
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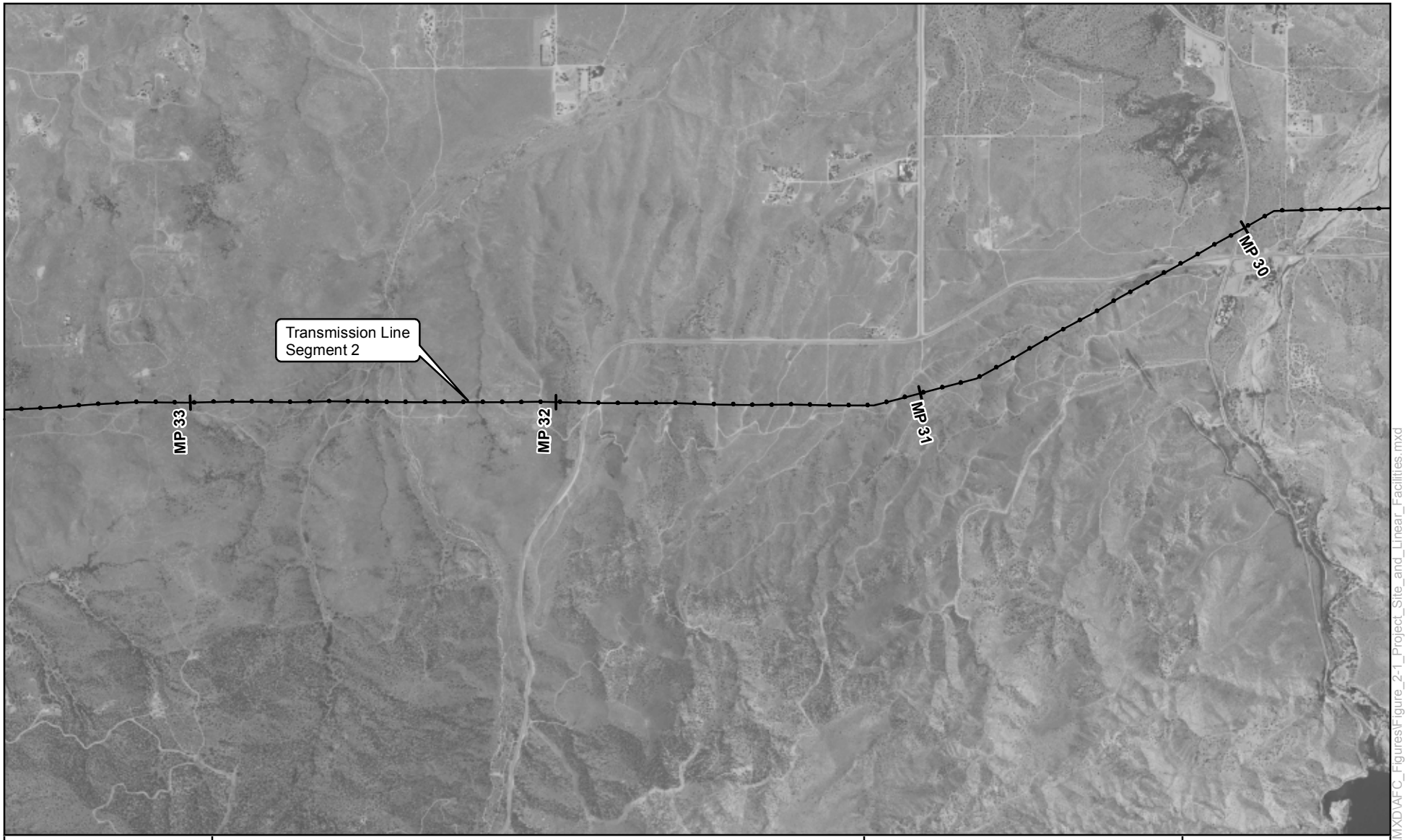
Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd



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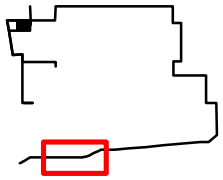

Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 10 of 14

PALMDALE
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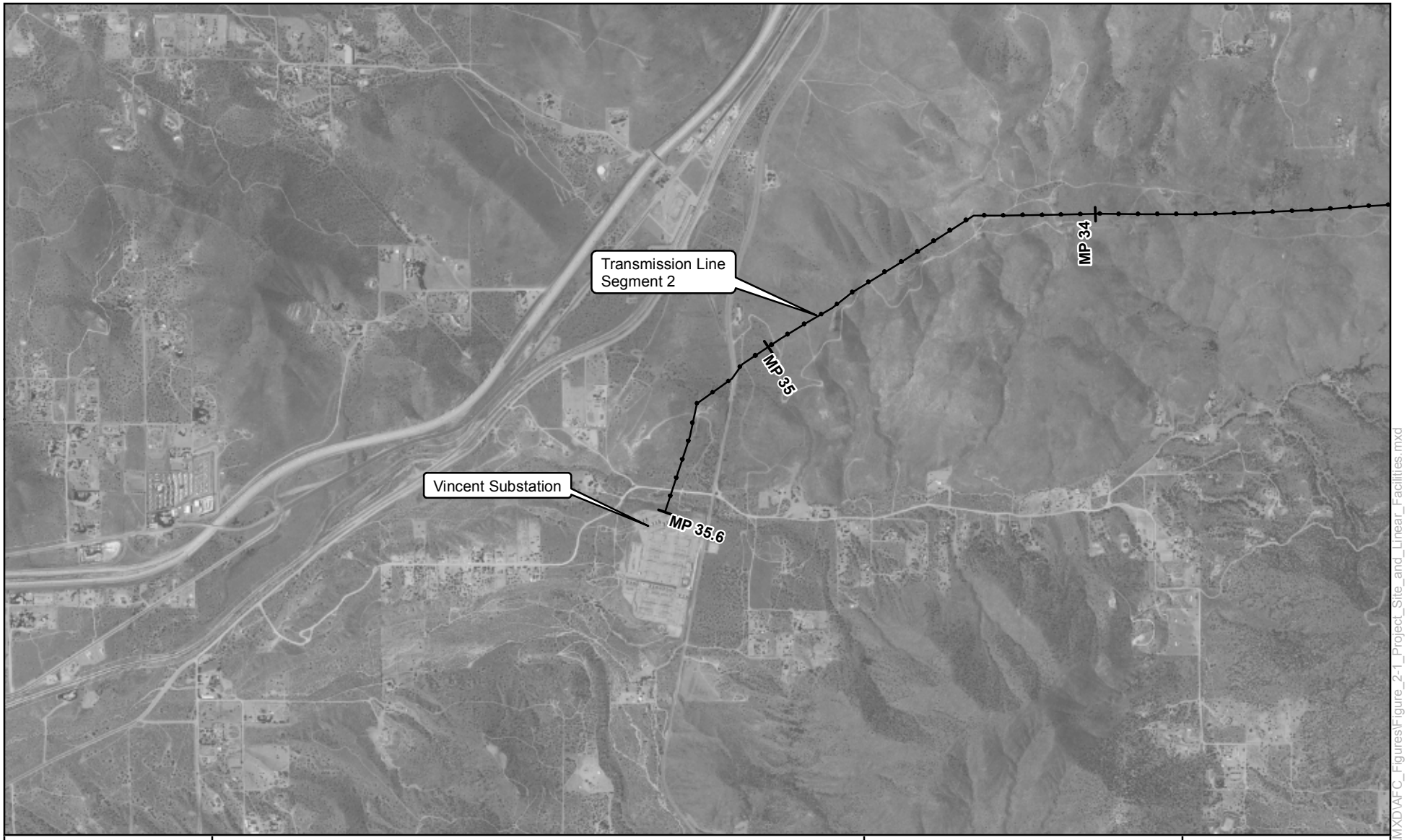
Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd



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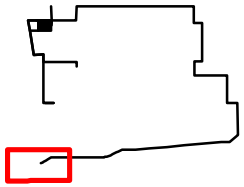

Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 11 of 14

PALMDALE
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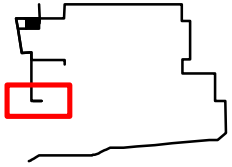
Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd

Map Location



Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

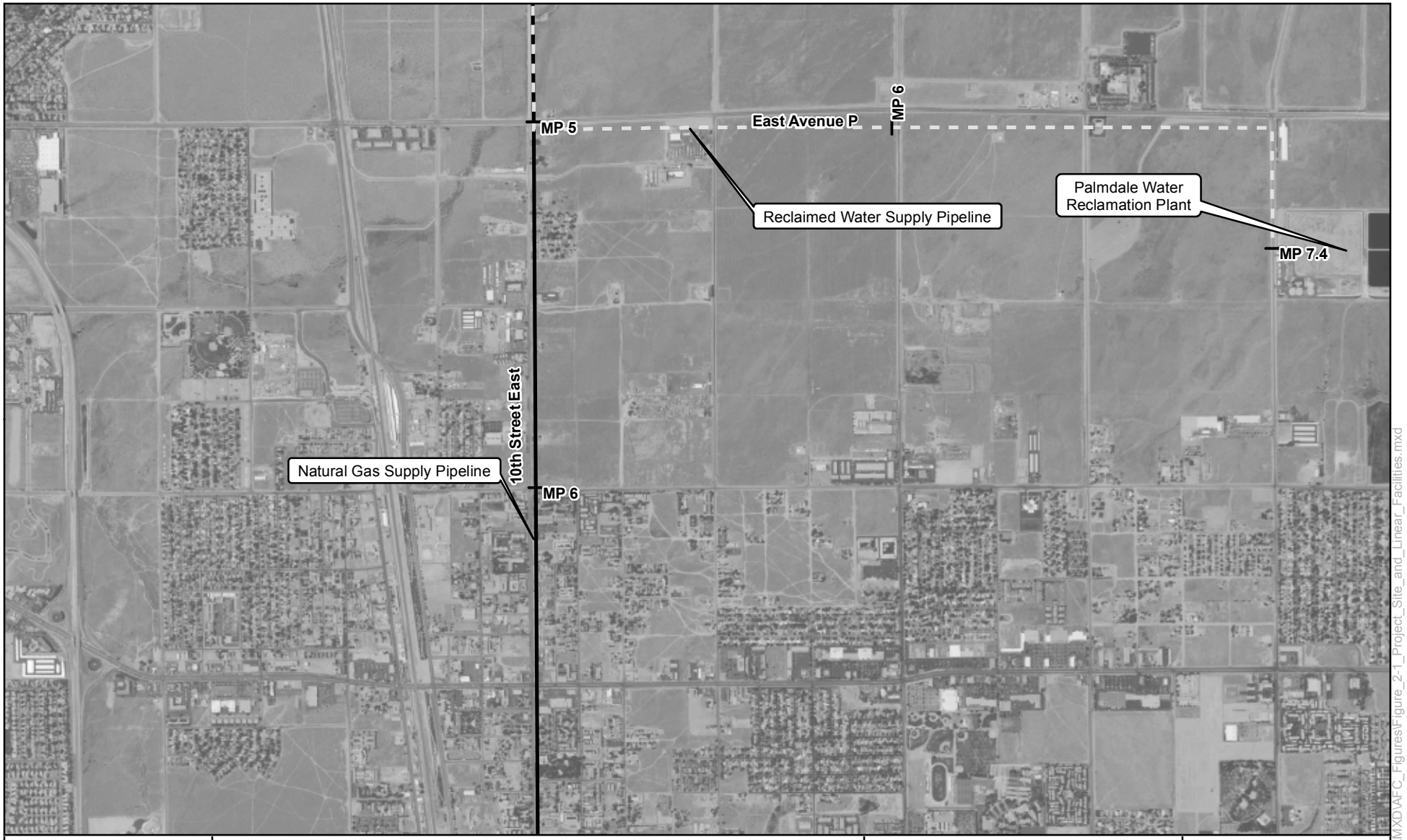
Figure 2-1
Project Site

Mapsheet 12 of 14

PALMDALE
a place to call home
Inland Energy, Inc.
ENSR | AECOM

Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd



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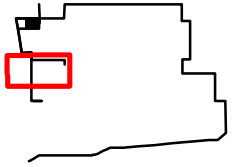

Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 13 of 14

PALMDALE
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Inland Energy, Inc.

ENSR | AECOM

Project: 10855-002
Date: July 2008

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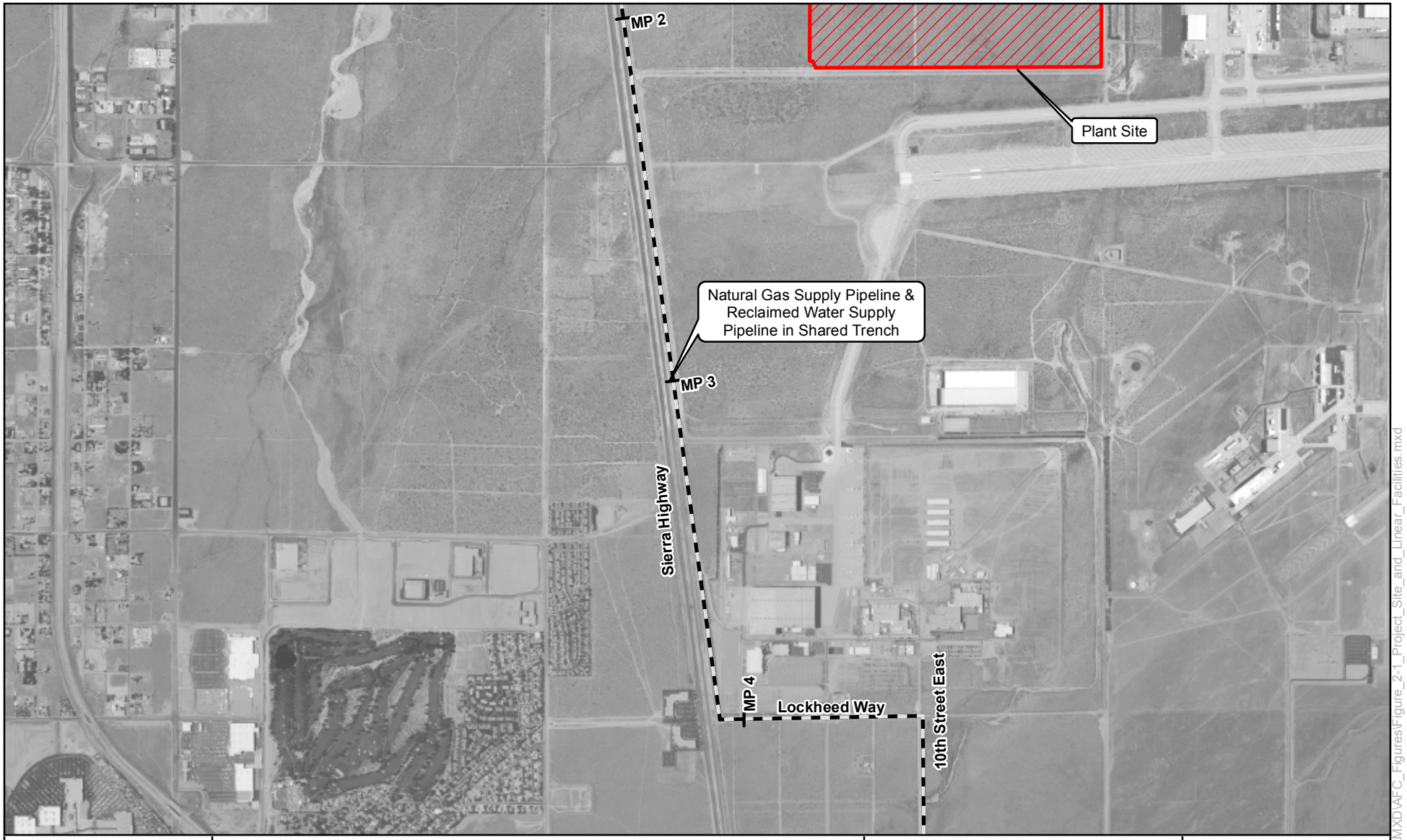
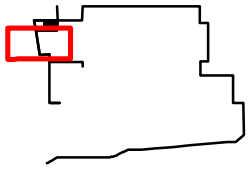


Map Location



Legend

- Plant Site
- Power Block
- Laydown Area
- Potable Water Line
- Natural Gas Supply Pipeline
- Reclaimed Water Supply Pipeline
- Sanitary Wastewater Pipeline
- Transmission Line

N W E S

1:24,000

0 2,000 4,000 6,000 Feet

Palmdale Hybrid Power Project

Figure 2-1
Project Site

Mapsheet 14 of 14

PALMDALE
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Inland Energy, Inc.

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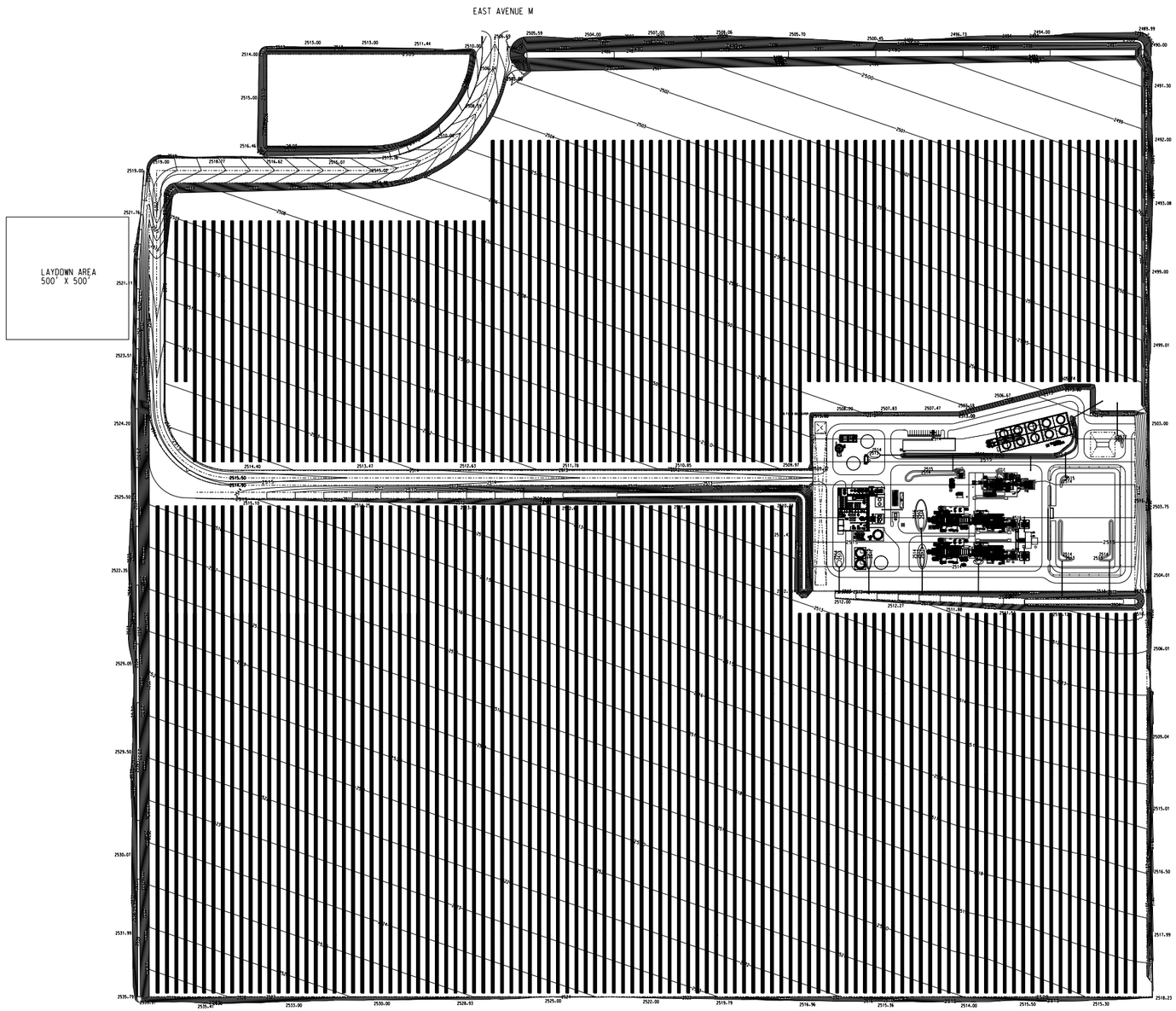
Project: 10855-002
Date: July 2008

Y:\Projects\InlandEnergy\PalmdaleMXD\AFC_Figures\Figure_2-1_Project_Site_and_Linear_Facilities.mxd

Figure 2-2 Plant Site Photographs – Existing Conditions

Figure 2-3a **Plant Site without Simulated Project Facilities**

Figure 2-3b **Plant Site with Simulated Project Facilities**



200 0 200 400

SCALE IN FEET

SCALE: 1" = 200'-0"

N

– PRELIMINARY –
NOT FOR CONSTRUCTION

CONFIDENTIAL

THESE DRAWINGS ARE CONFIDENTIAL IN NATURE. ANY MISUSE OR UNAUTHORIZED DISTRIBUTION OF THE DRAWINGS CONTAINED HEREIN WILL BE A VIOLATION OF THIS CONFIDENTIALITY REQUIREMENT AND SUBJECT THE VIOLATOR TO LIABILITY. USE OF THESE MATERIALS BY RECIPIENT SHALL CONSTITUTE ACCEPTANCE OF THE TERMS & CONDITIONS UNDERLYING CONFIDENTIALITY AGREEMENTS WE MAY HAVE EXECUTED IN OBTAINING THIS INFORMATION FROM A THIRD PARTY. IF THE RECIPIENT IS NOT IN AGREEMENT WITH THE OBLIGATION OF CONFIDENTIALITY THEN THE DRAWINGS SHALL BE RETURNED TO BIBB.

REV	DESCRIPTION	DWN	CHK	APP	DATE
B	ADDED LAYDOWN AREA. REVISED TITLE BLOCK INFORMATION	DAD		JAL	07-24-08
A	ISSUED FOR CEC APPLICATION	DAD		PAP	06-26-08

CITY OF PALMDALE

PALMDALE HYBRID
POWER PROJECT

Kiewit

Kiewit Power
8455 Lenexa Drive
Lenexa, Kansas 66214

FIGURE 2-4
GENERAL ARRANGEMENT
SITE PLAN

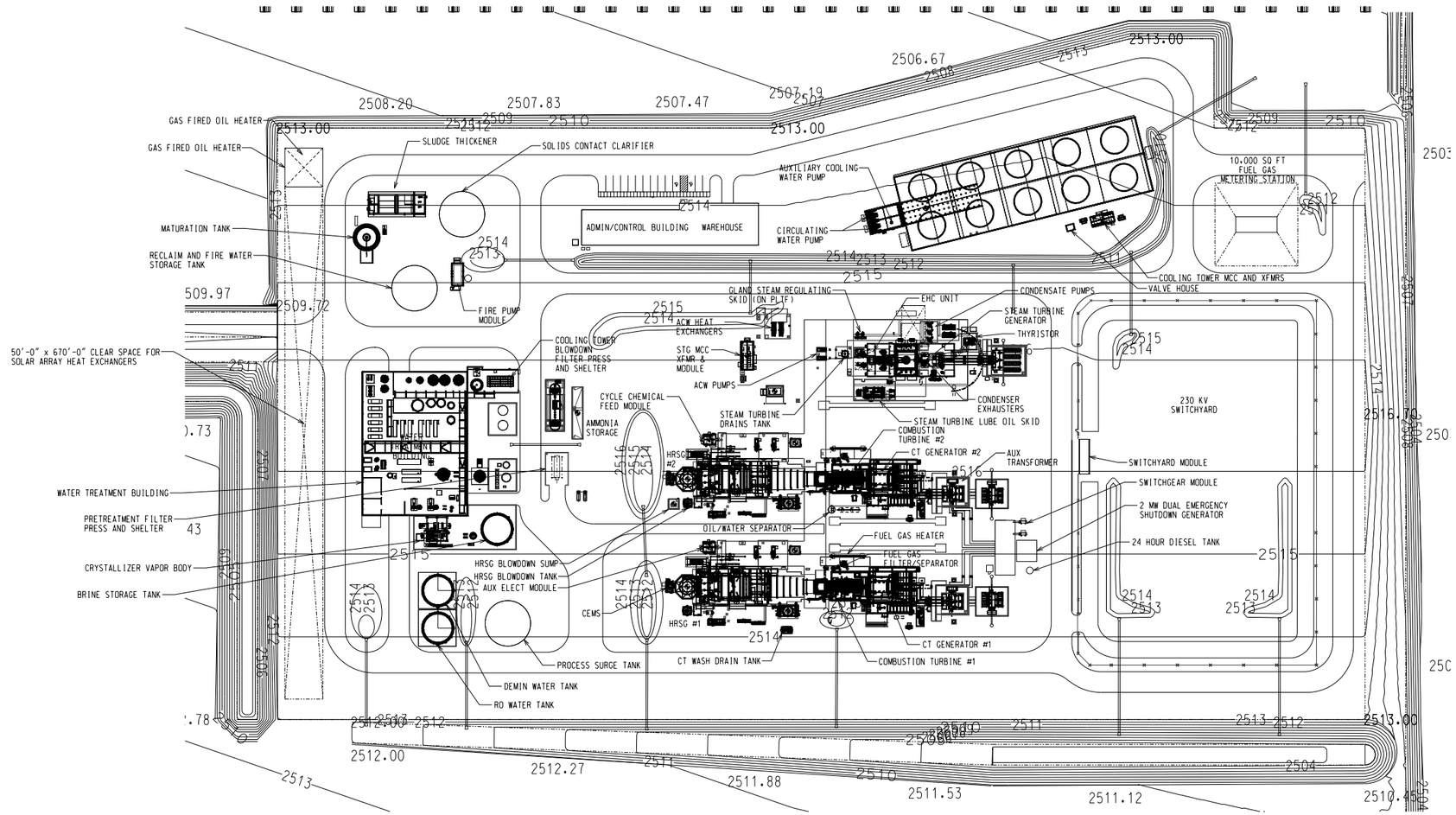
	by	date
DESIGNED	DAD	06-24-08
DRAWN	DAD	06-24-08
CHECKED		
APPROVED		

DRAWING NUMBER

2007-021-SP-001

NOTES:

1. IN FINAL DESIGN COOLING TOWERS WILL BE IN LINE WITH PERVAILING WIND CONDITION
2. ADDITIONAL AREA FOR SOLAR HEAT EXCHANGERS IF REQUIRED



60 0 60 120
SCALE IN FEET
SCALE: 1" = 60'-0"

N

- PRELIMINARY -
NOT FOR CONSTRUCTION

CONFIDENTIAL

THESE DRAWINGS ARE CONFIDENTIAL IN NATURE. ANY MISUSE OR UNAUTHORIZED DISTRIBUTION OF THE DRAWINGS CONTAINED HEREIN WILL BE A VIOLATION OF THIS CONFIDENTIALITY REQUIREMENT AND SUBJECT THE VIOLATOR TO LIABILITY. REVIEW OF THESE MATERIALS BY RECIPIENT SHALL CONSTITUTE AN ACCEPTANCE OF THESE TERMS AND THE TERMS OF ANY UNDERLYING CONFIDENTIALITY AGREEMENT WE MAY HAVE EXECUTED IN OBTAINING THIS INFORMATION FROM A THIRD PARTY. IF THE RECIPIENT IS NOT IN AGREEMENT WITH THE OBLIGATION OF CONFIDENTIALITY THEN THE DRAWINGS SHALL BE RETURNED TO BIBB.

REV	DESCRIPTION	DWN	CHK	APP	DATE
D	REVISED TITLE BLOCK INFORMATION	DAD		SJL	07-24-08
C	ISSUED FOR CEC APPLICATION	DAD		PAP	06-26-08
B	REVISED PLANT LAYOUT	JAL		RRT	06-26-07
A	PRELIMINARY	BDL		RRT	05-23-07

CITY OF PALMDALE

PALMDALE HYBRID POWER PROJECT

Kiewit

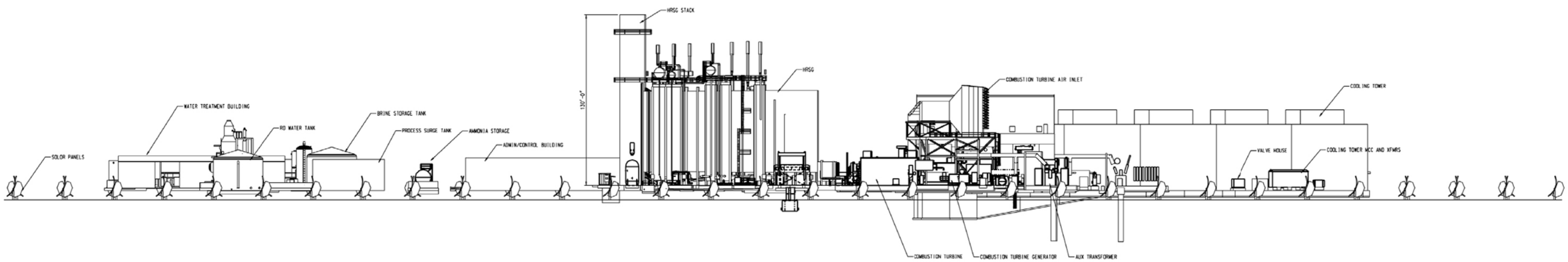
Kiewit Power
8455 Lenexa Drive
Lenexa, Kansas 66214

FIGURE 2-5
GENERAL ARRANGMENT
POWER BLOCK

	by	date
DESIGNED	RRT	05-23-07
DRAWN	BDL	05-23-07
CHECKED	---	----
APPROVED	---	----

DRAWING NUMBER

2007-021-PP-001



SITE ELEVATION LOOKING NORTH

30 0 30 60
SCALE IN FEET

Palmdale Hybrid Power Project

Figure 2-6
Site Elevation

PALMDALE
a place to call home
Inland Energy, Inc.
ENSR | AECOM

Project: 10855-002
Date: July 2008

FILENAME:

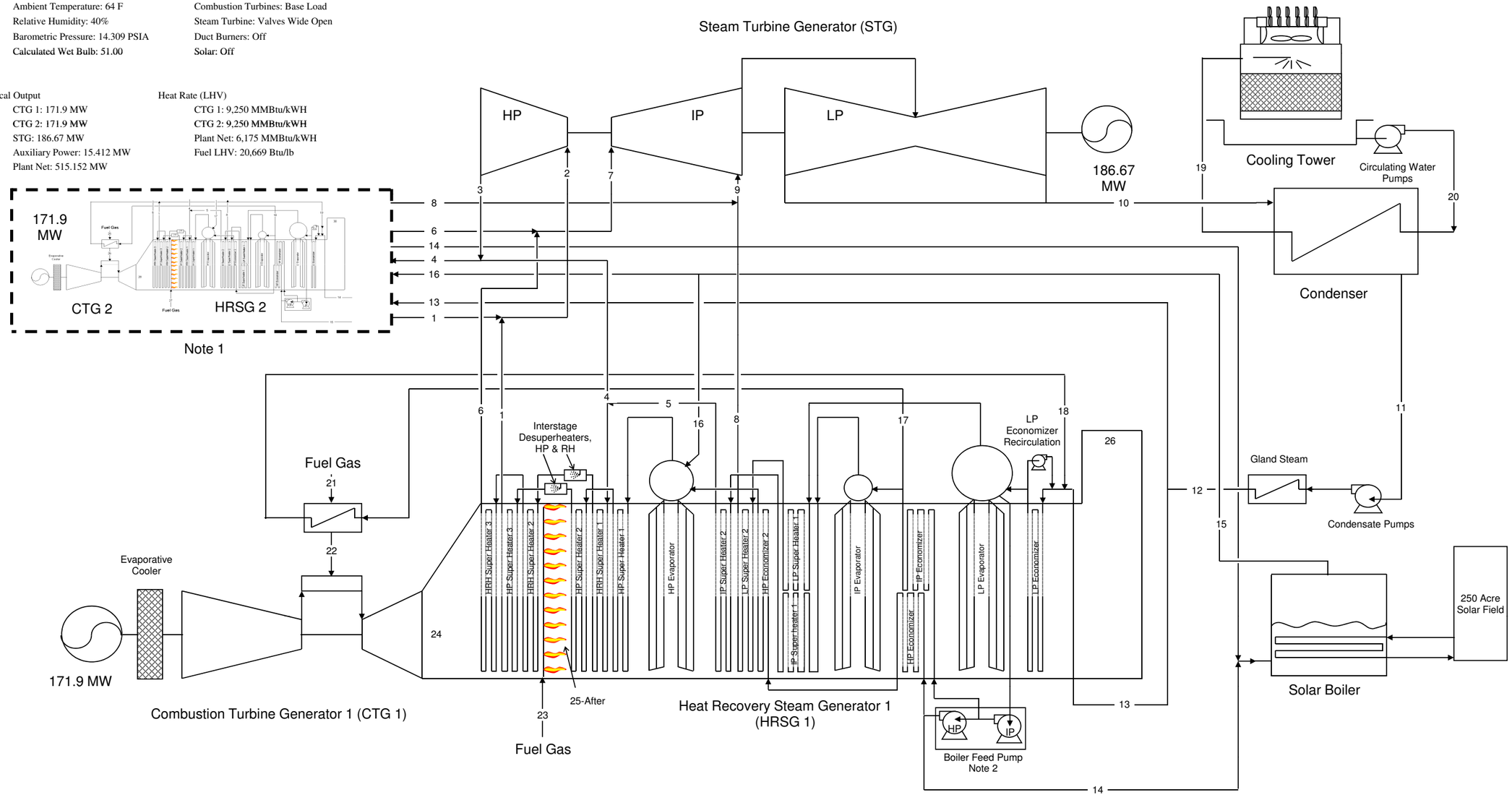
Plant Performance:

Ambient Conditions:
- Ambient Temperature: 64 F
- Relative Humidity: 40%
- Barometric Pressure: 14.309 PSIA
- Calculated Wet Bulb: 51.00

Operating Condition:
- Combustion Turbines: Base Load
- Steam Turbine: Valves Wide Open
- Duct Burners: Off
- Solar: Off

Electrical Output
- CTG 1: 171.9 MW
- CTG 2: 171.9 MW
- STG: 186.67 MW
- Auxiliary Power: 15.412 MW
- Plant Net: 515.152 MW

Heat Rate (LHV)
- CTG 1: 9,250 MMBtu/kWH
- CTG 2: 9,250 MMBtu/kWH
- Plant Net: 6,175 MMBtu/kWH
- Fuel LHV: 20,669 Btu/lb



Description	Steam Cycle																		Circ. Water		Fuel			CT Exhaust																
Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Mass Flow, kpph	428.2	856.4	839.9	420	54.6	476.1	952	61.5	122.9	1087	1091	1091	545.7	0	0	0	46.67	46.67	60088	57682	77	77	0	3544		3544														
Temperature, F	1040	1035	718.1	715	557	1042	1039	554.3	550.6	93.6	93.6	95.9	95.9				407.6		85.5	67	59	365		1110		190.6														
Pressure, PSIA	1229	1165	353.3	340.5	345.6	320.5	304.3	73	62	0.781	0.781													14.85																
Enthalpy, Btu/lb	1522	1521	1376	1375	1287	1548	1547	1309	1308	1040																														

Notes:
1. Both CT/HRSG trains are identical. Only CT/HRSG #1 is shown. Streams coming from CT/HRSG #2 are shown coming from or returning to a boundary line.
2. Boiler Feed Pump is one pump. It is shown as two pumps to separate the IP and HP stages
3. Steam Turbine Bypass not shown for clarity
4. For information blowdown, evaporation, drift make-up and water treatment see project water balances
5. Data is based on the Kiewit heat balance document-ID No. GC561-062008-1 dated 6/20/08
6. Auxiliary Cooling Water loop not shown for clarity

REV.	DESCRIPTION		
B	UPDATED TITLE BLOCK	AJD	7-23-08
A	ISSUED FOR REVIEW	AJD	7-18-08

Kiewit

PALMDALE HYBRID POWER PROJECT

Figure 2-7a
Heat Balance
Base Load

Heat Balance, Case PB-3
Unfired, Solar Off
64 F, 40% RH, 14.309 PSIA

SHEET 1 of 1

DRAWING NUMBER 2007021HB001

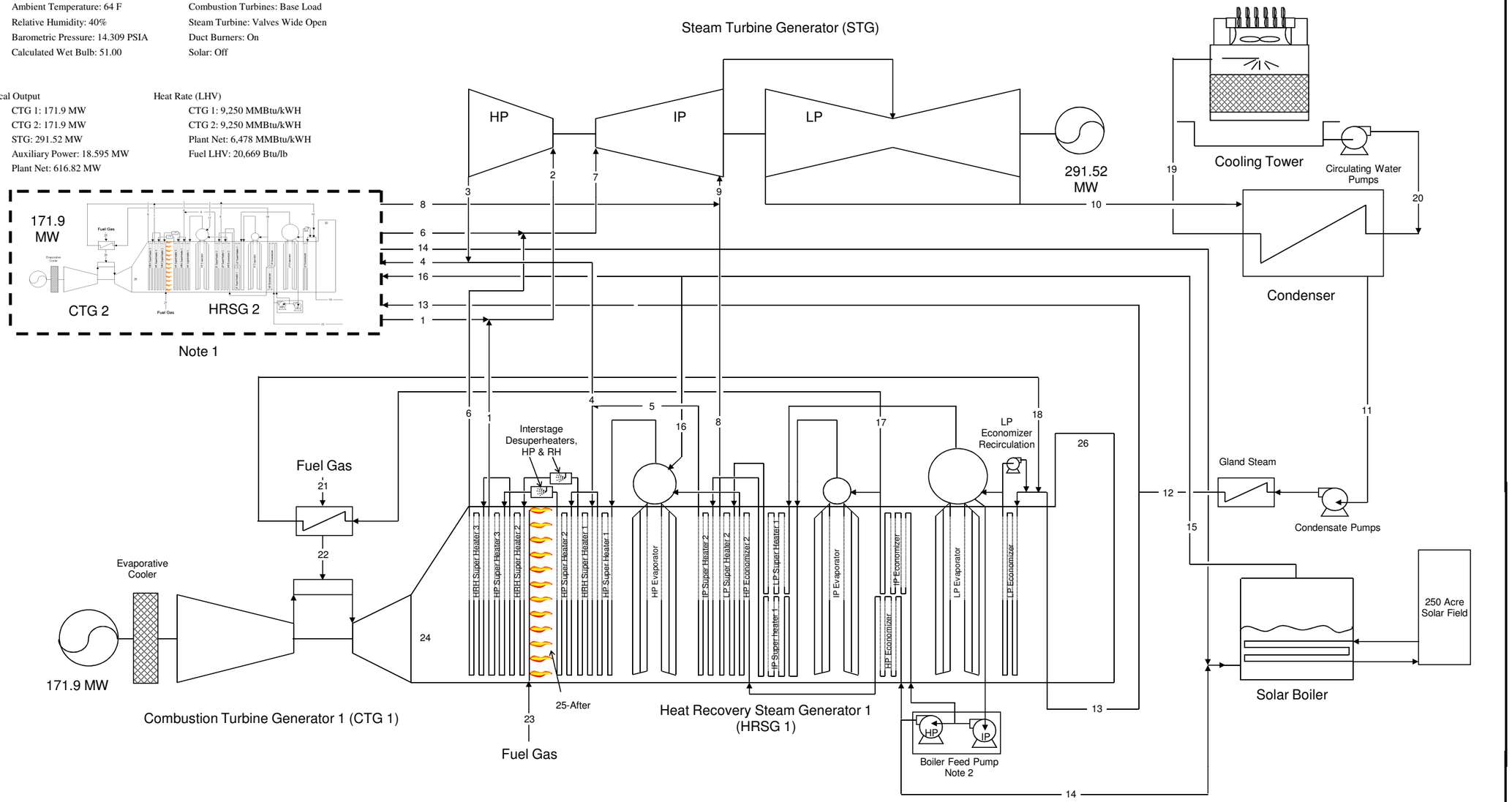
Plant Performance:

Ambient Conditions:
- Ambient Temperature: 64 F
- Relative Humidity: 40%
- Barometric Pressure: 14.309 PSIA
- Calculated Wet Bulb: 51.00

Operating Condition:
- Combustion Turbines: Base Load
- Steam Turbine: Valves Wide Open
- Duct Burners: On
- Solar: Off

Electrical Output
- CTG 1: 171.9 MW
- CTG 2: 171.9 MW
- STG: 291.52 MW
- Auxiliary Power: 18.595 MW
- Plant Net: 616.82 MW

Heat Rate (LHV)
- CTG 1: 9,250 MMBtu/kWH
- CTG 2: 9,250 MMBtu/kWH
- Plant Net: 6,478 MMBtu/kWH
- Fuel LHV: 20,669 Btu/lb



Description	Steam Cycle																		Circ. Water		Fuel			CT Exhaust															
Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Mass Flow, kpph	708.8	1418	1391	695.3	26.31	753	1506	32.5	65	1592	1598	1598	799	0	0	0	37.13	37.13	60066	57659	76.95	76.95	19.71	3544		3564														
Temperature, F	1042	1036	703.9	700	611.6	1053	1050	609.2	606.9	108.3	108.3	109.8	109.8				466.8		96.7	70.4	59	365.1		1110	1413	176.1														
Pressure, PSIA	1999	1895	558.7	537.6	542.6	506.7	481.3	93.5	91.1	1.212	1.212													14.850																
Enthalpy, Btu/lb	1501	1500	1357	1356	1303	1549	1548	1335	1334	1037																														

Notes:
1. Both CT/HRSG trains are identical. Only CT/HRSG #1 is shown. Streams coming from CT/HRSG #2 are shown coming from or returning to a boundary line.
2. Boiler Feed Pump is one pump. It is shown as two pumps to separate the IP and HP stages
3. Steam Turbine Bypass not shown for clarity
4. For information blowdown, evaporation, drift make-up and water treatment see project water balances
5. Data is based on the Kiewit heat balance document-ID No. GC561-062008-1 dated 6/20/08
6. Auxiliary Cooling Water loop not shown for clarity

REV.	DESCRIPTION		
B	UPDATED TITLE BLOCK	AJD	7-23-08
A	ISSUED FOR REVIEW	AJD	7-18-08

Kiewit

PALMDALE HYBRID POWER PROJECT

Figure 2-7b
Heat Balance
Peak Load - No Solar

Heat Balance, Case PB-19
Fired, Solar Off
64 F, 40% RH, 14.309 PSIA

SHEET 1 of 1

DRAWING NUMBER 2007021HB003

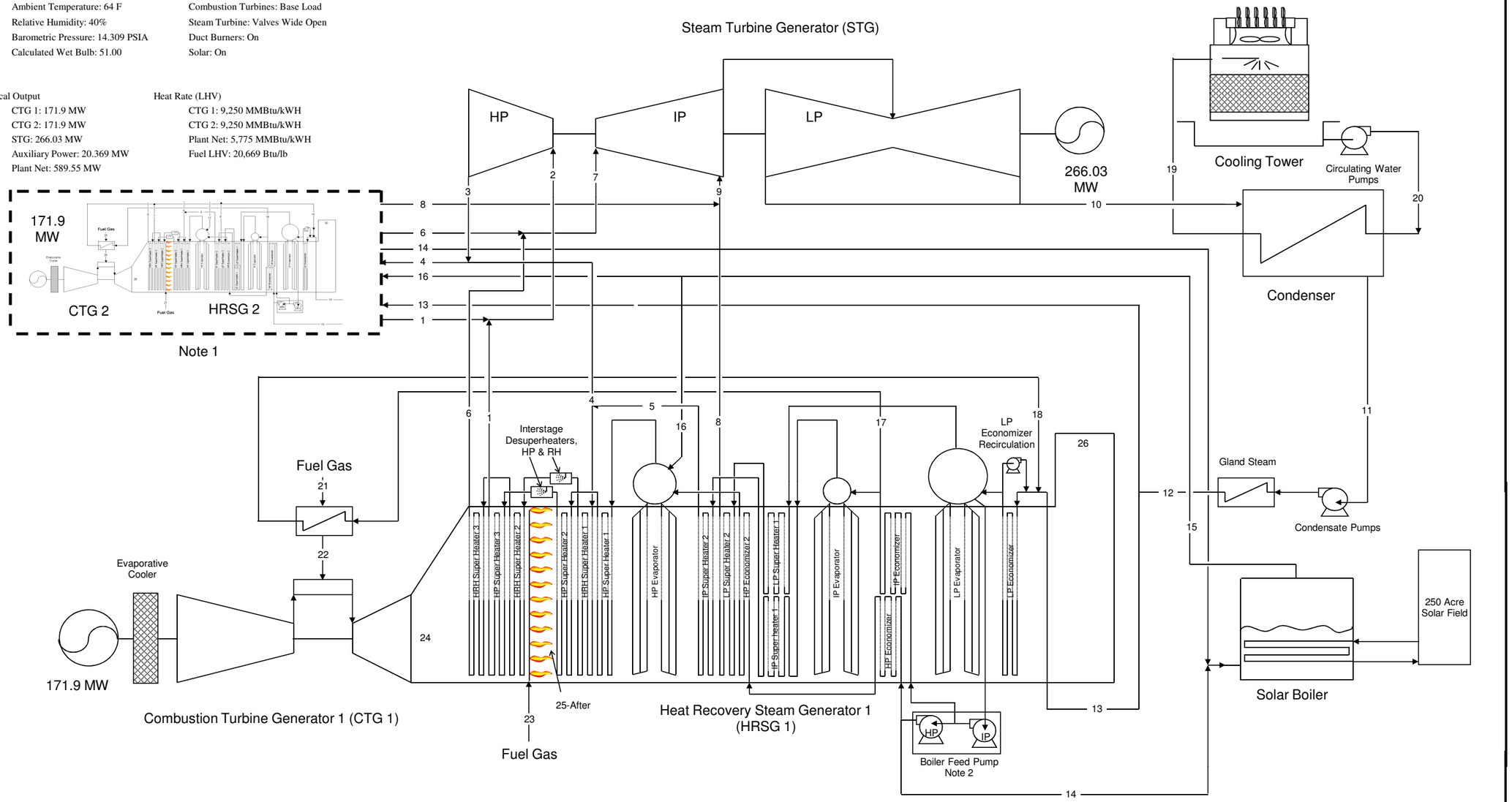
Plant Performance:

Ambient Conditions:
- Ambient Temperature: 64 F
- Relative Humidity: 40%
- Barometric Pressure: 14.309 PSIA
- Calculated Wet Bulb: 51.00

Operating Condition:
- Combustion Turbines: Base Load
- Steam Turbine: Valves Wide Open
- Duct Burners: On
- Solar: On

Electrical Output
- CTG 1: 171.9 MW
- CTG 2: 171.9 MW
- STG: 266.03 MW
- Auxiliary Power: 20.369 MW
- Plant Net: 589.55 MW

Heat Rate (LHV)
- CTG 1: 9,250 MMBtu/kWH
- CTG 2: 9,250 MMBtu/kWH
- Plant Net: 5,775 MMBtu/kWH
- Fuel LHV: 20,669 Btu/lb



Description	Steam Cycle																		Circ. Water		Fuel			CT Exhaust															
Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Mass Flow, kpph	647.4	1295	1269	634.4	69.34	816.5	1633	41.11	82.22	1735	1741	1741	870.7	322	643.9	643.9	40.61	40.61	60062	57655	76.95	76.95	5.42	3544		3549														
Temperature, F	873.4	866	601.2	597.5	584.1	894.6	891	607.8	605.3	110.8	110.8	112.1	112.1	331.3	650	644.7	446		98.6	70.9	59	365		1110	932.7	174.1														
Pressure, PSIA	1698	1611	557.3	541.7	546.7	515.9	490	97.3	93.5	1.607	1.304			2063	1869	1818								14.85																
Enthalpy, Btu/lb	1404	1403	1295	1294	1285	1463	1462	1334	1333	1008				305.5	1191	1191																								

Notes:
1. Both CT/HRSG trains are identical. Only CT/HRSG #1 is shown. Streams coming from CT/HRSG #2 are shown coming from or returning to a boundary line.
2. Boiler Feed Pump is one pump. It is shown as two pumps to separate the IP and HP stages
3. Steam Turbine Bypass not shown for clarity
4. For information blowdown, evaporation, drift make-up and water treatment see project water balances
5. Data is based on the Kiewit heat balance document-ID No. GC561-062008-1 dated 6/20/08
6. Auxiliary Cooling Water loop not shown for clarity

REV.	DESCRIPTION		
B	UPDATED TITLE BLOCK	AJD	7-23-08
A	ISSUED FOR REVIEW	AJD	7-18-08

Kiewit

PALMDALE HYBRID POWER PROJECT

Figure 2-7c
Heat Balance
Peak Load -
Full Solar

Heat Balance, Case PB-13
Fired, Max Solar
64 F, 40% RH, 14.309 PSIA

SHEET 1 of 1

DRAWING NUMBER 2007021HB002

Figure 2-8 **Photograph of Solar Array Field**

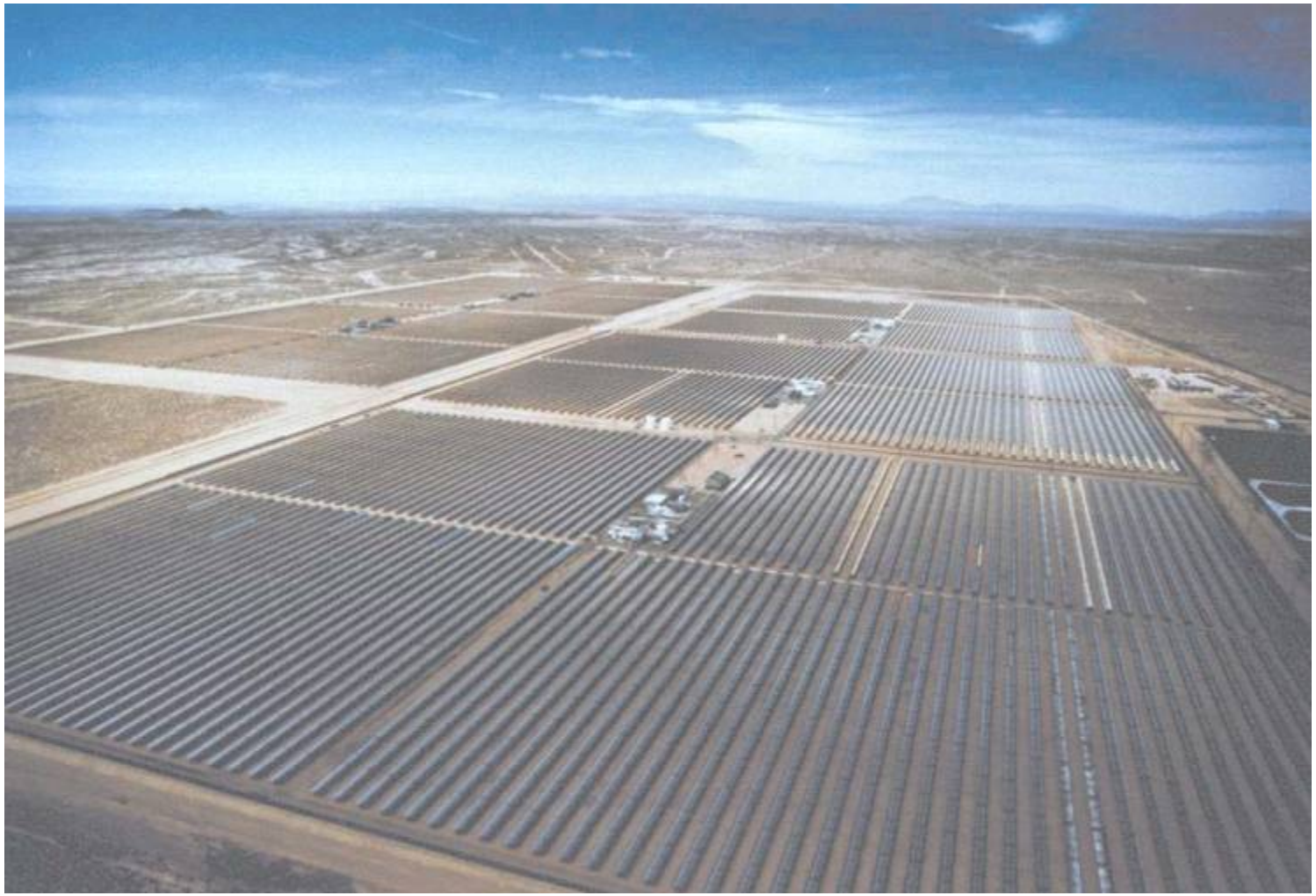
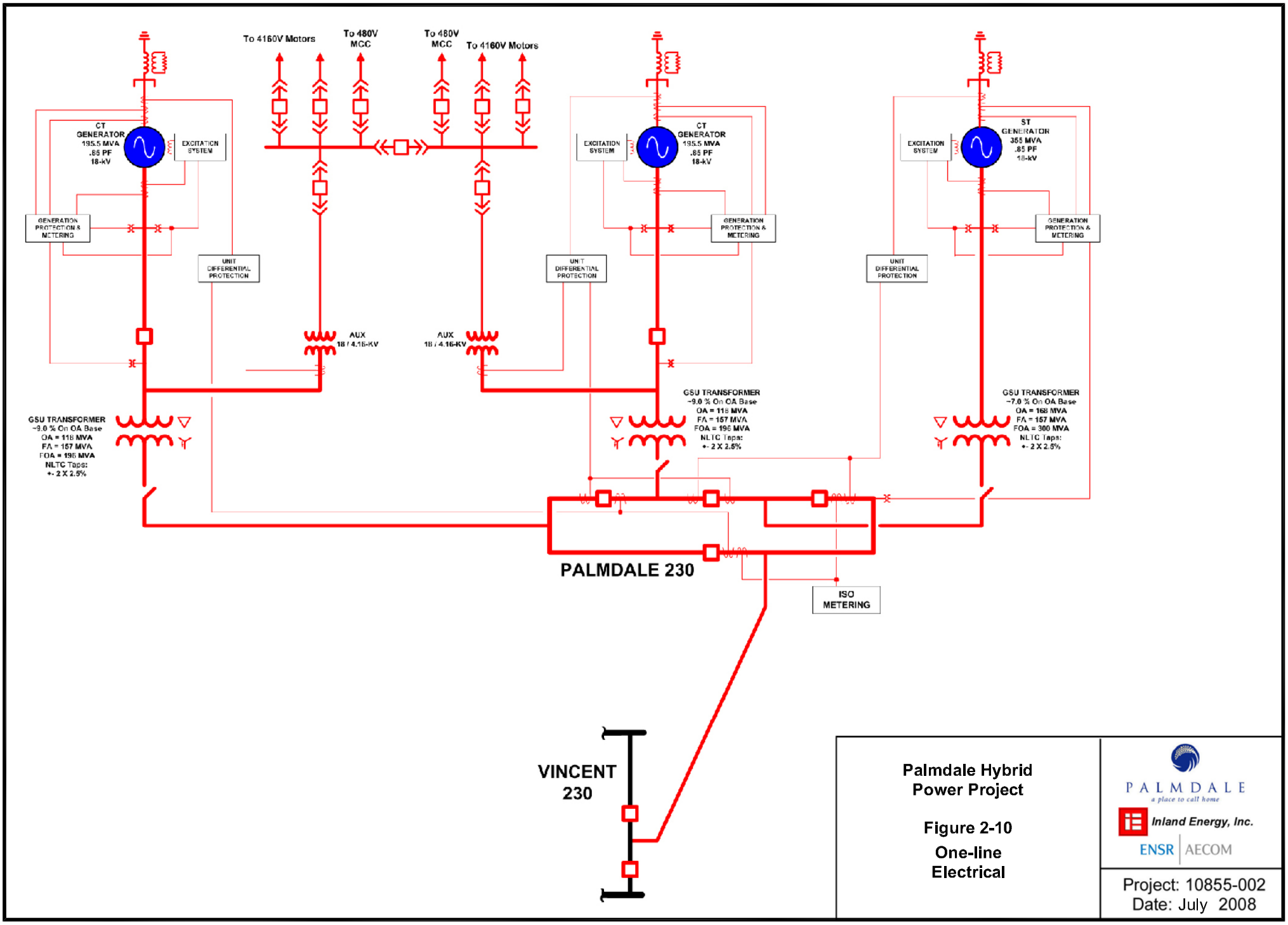


Figure 2-9 **Aerial Photograph of 150 MW Kramer Junction SEGS Site**



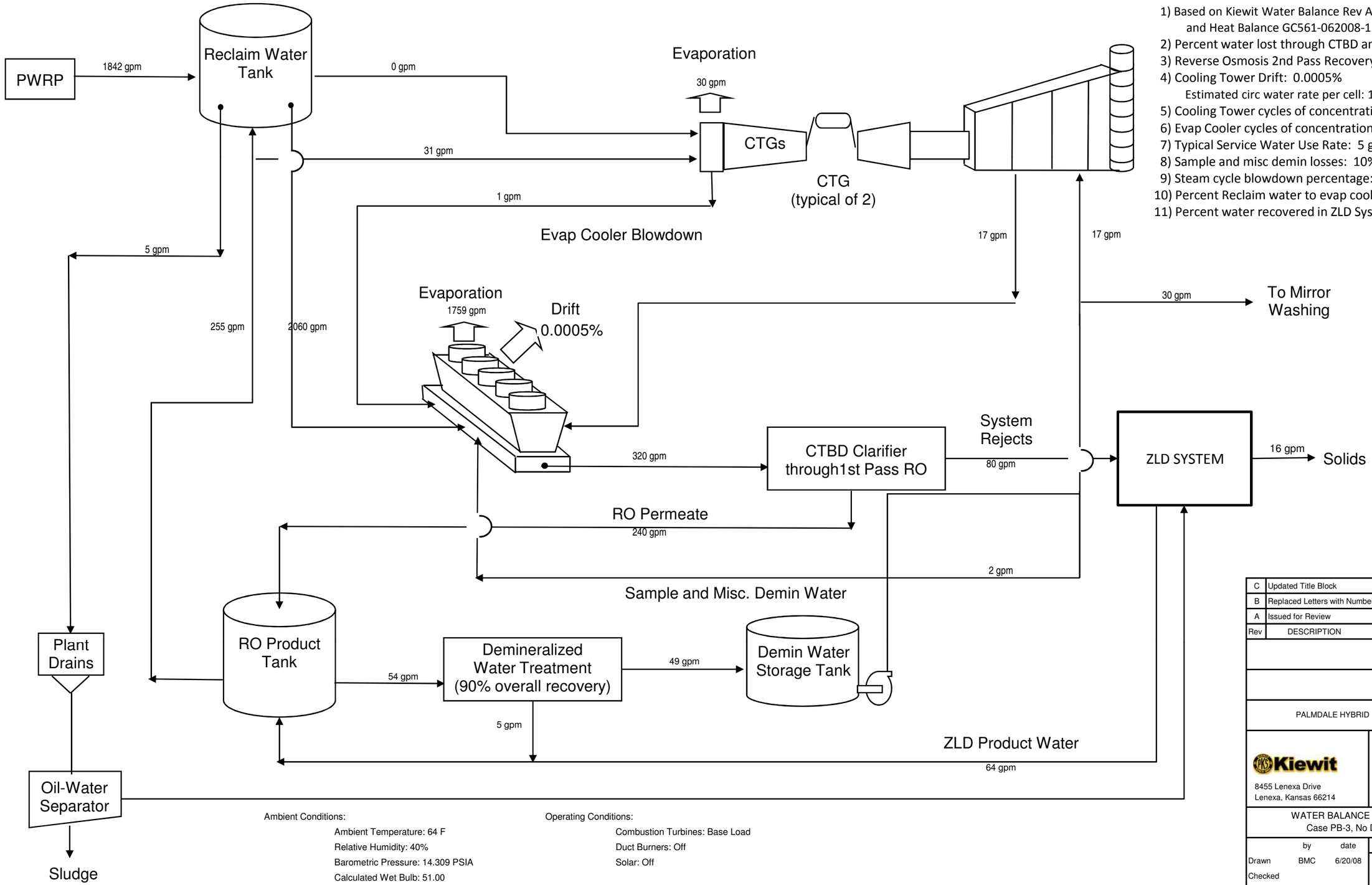
Palmdale Hybrid Power Project

Figure 2-10

One-line Electrical

PALMDALE
a place to call home
Inland Energy, Inc.
ENSR | AECOM

Project: 10855-002
Date: July 2008



Notes:

1) Based on Kiewit Water Balance Rev A dated 6/24/08, and Heat Balance GC561-062008-1 dated 6/20/08
2) Percent water lost through CTBD and 1st Pass: 25%
3) Reverse Osmosis 2nd Pass Recovery Rate: 90%
4) Cooling Tower Drift: 0.0005%
   Estimated circ water rate per cell: 15000 (0.90 gpm)
5) Cooling Tower cycles of concentration: 6.50
6) Evap Cooler cycles of concentration: 50.00
7) Typical Service Water Use Rate: 5 gpm
8) Sample and misc demin losses: 10%
9) Steam cycle blowdown percentage: 1%
10) Percent Reclaim water to evap cooler: 0%
11) Percent water recovered in ZLD System: 80%

Ambient Conditions:

Ambient Temperature: 64 F
Relative Humidity: 40%
Barometric Pressure: 14.309 PSIA
Calculated Wet Bulb: 51.00

Operating Conditions:

Combustion Turbines: Base Load
Duct Burners: Off
Solar: Off

Rev	DESCRIPTION	Dwn	Chk	App	Date
C	Updated Title Block	AJD			7/23/08
B	Replaced Letters with Numbers	AJD			7/17/08
A	Issued for Review	BMC			6/24/08

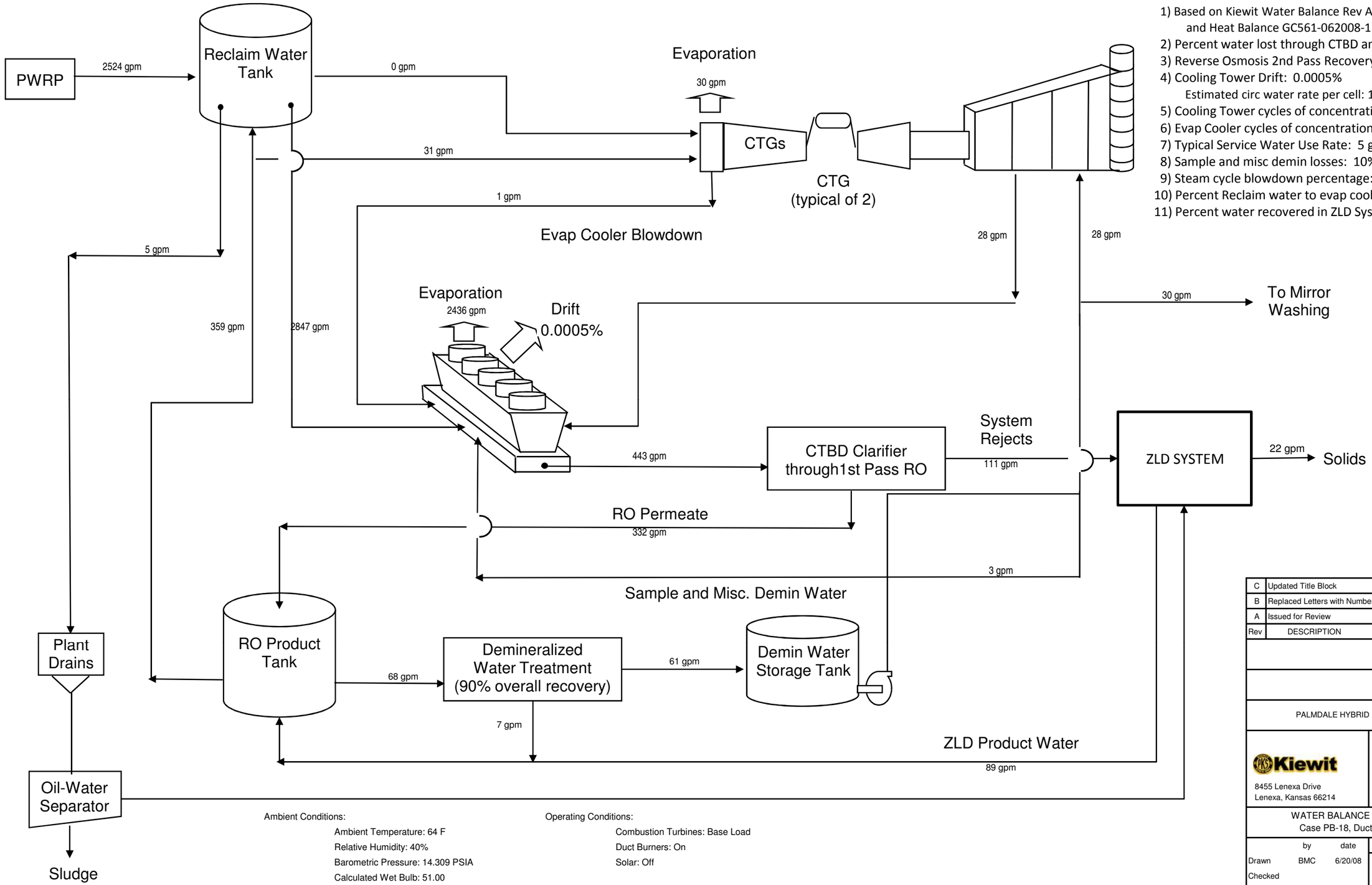
PALMDALE HYBRID POWER PROJECT

Kiewit
8455 Lenexa Drive
Lenexa, Kansas 66214

Figure 2-11a
Water Balance
Base Load

WATER BALANCE FLOW DIAGRAM
Case PB-3, No Duct, No Solar

	by	date	DRAWING NUMBER
Drawn	BMC	6/20/08	2007021WB001
Checked			
Approved			



Notes:

1) Based on Kiewit Water Balance Rev A dated 6/24/08, and Heat Balance GC561-062008-1 dated 6/20/08
2) Percent water lost through CTBD and 1st Pass: 25%
3) Reverse Osmosis 2nd Pass Recovery Rate: 90%
4) Cooling Tower Drift: 0.0005%
   Estimated circ water rate per cell: 15000 (0.90 gpm)
5) Cooling Tower cycles of concentration: 6.50
6) Evap Cooler cycles of concentration: 50.00
7) Typical Service Water Use Rate: 5 gpm
8) Sample and misc demin losses: 10%
9) Steam cycle blowdown percentage: 1%
10) Percent Reclaim water to evap cooler: 0%
11) Percent water recovered in ZLD System: 80%

Ambient Conditions:

Ambient Temperature: 64 F
Relative Humidity: 40%
Barometric Pressure: 14.309 PSIA
Calculated Wet Bulb: 51.00

Operating Conditions:

Combustion Turbines: Base Load
Duct Burners: On
Solar: Off

Rev	DESCRIPTION	Dwn	Chk	App	Date
C	Updated Title Block	AJD			7/23/08
B	Replaced Letters with Numbers	AJD			7/17/08
A	Issued for Review	BMC			6/24/08

PALMDALE HYBRID POWER PROJECT

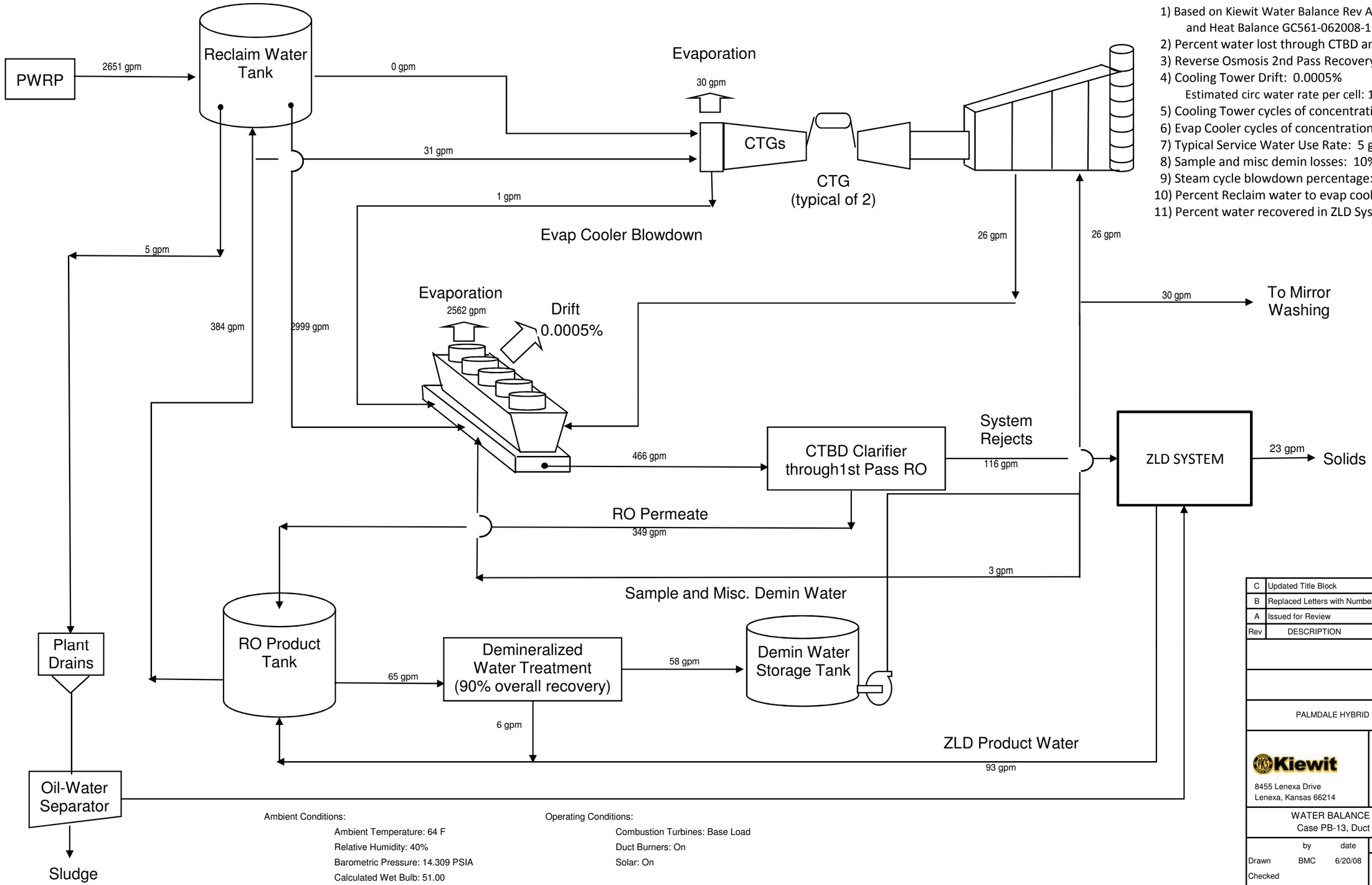
Kiewit
8455 Lenexa Drive
Lenexa, Kansas 66214

Figure 2-11b
Water Balance
Peak Load -
No Solar

WATER BALANCE FLOW DIAGRAM
Case PB-18, Duct Fired, No Solar

	by	date
Drawn	BMC	6/20/08
Checked		
Approved		

DRAWING NUMBER
2007021WB003



Notes:

1) Based on Kiewit Water Balance Rev A dated 6/24/08, and Heat Balance GC561-062008-1 dated 6/20/08
2) Percent water lost through CTBD and 1st Pass: 25%
3) Reverse Osmosis 2nd Pass Recovery Rate: 90%
4) Cooling Tower Drift: 0.0005%
   Estimated circ water rate per cell: 15000 (0.90 gpm)
5) Cooling Tower cycles of concentration: 6.50
6) Evap Cooler cycles of concentration: 50.00
7) Typical Service Water Use Rate: 5 gpm
8) Sample and misc demin losses: 10%
9) Steam cycle blowdown percentage: 1%
10) Percent Reclaim water to evap cooler: 0%
11) Percent water recovered in ZLD System: 80%

Ambient Conditions:

Ambient Temperature: 64 F
Relative Humidity: 40%
Barometric Pressure: 14.309 PSIA
Calculated Wet Bulb: 51.00

Operating Conditions:

Combustion Turbines: Base Load
Duct Burners: On
Solar: On

Rev	DESCRIPTION	Dwn	Chk	App	Date
C	Updated Title Block	AJD			7/23/08
B	Replaced Letters with Numbers	AJD			7/17/08
A	Issued for Review	BMC			6/24/08

PALMDALE HYBRID POWER PROJECT

Kiewit
8455 Lenexa Drive
Lenexa, Kansas 66214

Figure 2-11c
Water Balance
Peak Load -
Full Solar

WATER BALANCE FLOW DIAGRAM
Case PB-13, Duct Fired, Max Solar

	by	date
Drawn	BMC	6/20/08
Checked		
Approved		

DRAWING NUMBER
2007021WB002

Figure 2.12a

Transmission Line Segment 1 - Existing Conditions

Figure 2.12b

Transmission Line Route Segment 1 - With Simulated PHPP Facilities

Figure 2.13a

Transmission Line Segment 2 - Existing Condition

Figure 2.13b

Transmission Line Segment 2 – With Simulated PHPP Facilities